Louisiana Energy Services
Environmental Report
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1.0 PROPOSED ACTIVITIES

This Environmental Report is submitted in support of Louisiana Energy Services' application for a license to construct and operate the Claiborne Enrichment Center (CEC), located in Claiborne Parish, Louisiana.

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1.1 BACKGROUND INFORMATION

The facility is located approximately 5 miles northeast of Homer, Louisiana at the intersection of Louisiana State Route #9 and Parish Road #39. The location of the facility is shown in Figure 1.1-1.

Louisiana Energy Services (LES) is the owner and operator of the facility. Currently, its offices are in Washington, D.C. LES is a Delaware limited partnership. It has been formed to provide uranium enrichment services for commercial nuclear power plants. That is its only business. LES has no subsidiaries or divisions. The general partners are as follows:

- Urenco Investments, Inc., a Delaware corporation and wholly-owned subsidiary of Urenco, Ltd. (Urenco), a corporation formed under the laws of the United Kingdom which is owned in equal shares by British Nuclear Fuels plc (BNFL), Ultra-Centrifuge Nederland NV (UCN), a Netherlands corporation, and Uranit GmbH (Uranit), a corporation formed under the laws of the Federal Republic of Germany. BNFL is wholly-owned by the Department of Energy of the Government of the United Kingdom. UCN is 99% owned by the Government of the Netherlands, with the remaining 1% owned collectively by the Royal Dutch Shell Group, the Dutch State Mines, Philips Gloeilampenfabrieken N.V. and VMF-STORK. Uranit is owned by PreussenElektra AG (37.5%), RWE-DEA AG (37.5%) and Hoechst AG (25%), all of which are corporations formed under the laws of the Federal Republic of Germany.

- Claiborne Fuels L.P., a Delaware limited partnership of which Claiborne Fuels, Inc., a California corporation and wholly-owned subsidiary of Fluor Daniel, Inc. (FDI). FDI is the sole general partner. FDI is a California Corporation and wholly owned subsidiary of Fluor Corporation, a publicly-held Delaware corporation.

- Claiborne Energy Services, Inc., a Louisiana corporation and wholly-owned subsidiary of Duke Power Company, a publicly - held North Carolina corporation.

- Graystone Corporation, a Minnesota corporation and wholly-owned subsidiary of Northern States Power Company, a publicly-held Minnesota corporation.

The limited partners are as follows:

- Louisiana Power & Light Company, a Louisiana corporation and wholly-owned subsidiary of Entergy Corporation, a publicly-held Florida corporation and a public utility holding company.

- BNFL Enrichment (Investments US) Ltd., a corporation formed under the laws of the United Kingdom and a wholly-owned subsidiary of BNFL).

- GnV, a corporation formed under the laws of the Federal Republic of Germany and a wholly-owned subsidiary of Uranit.

- UCN Deelnemingen B.V., a Netherlands corporation and wholly-owned subsidairy of UCN.

- Claiborne Energy Services, Inc.

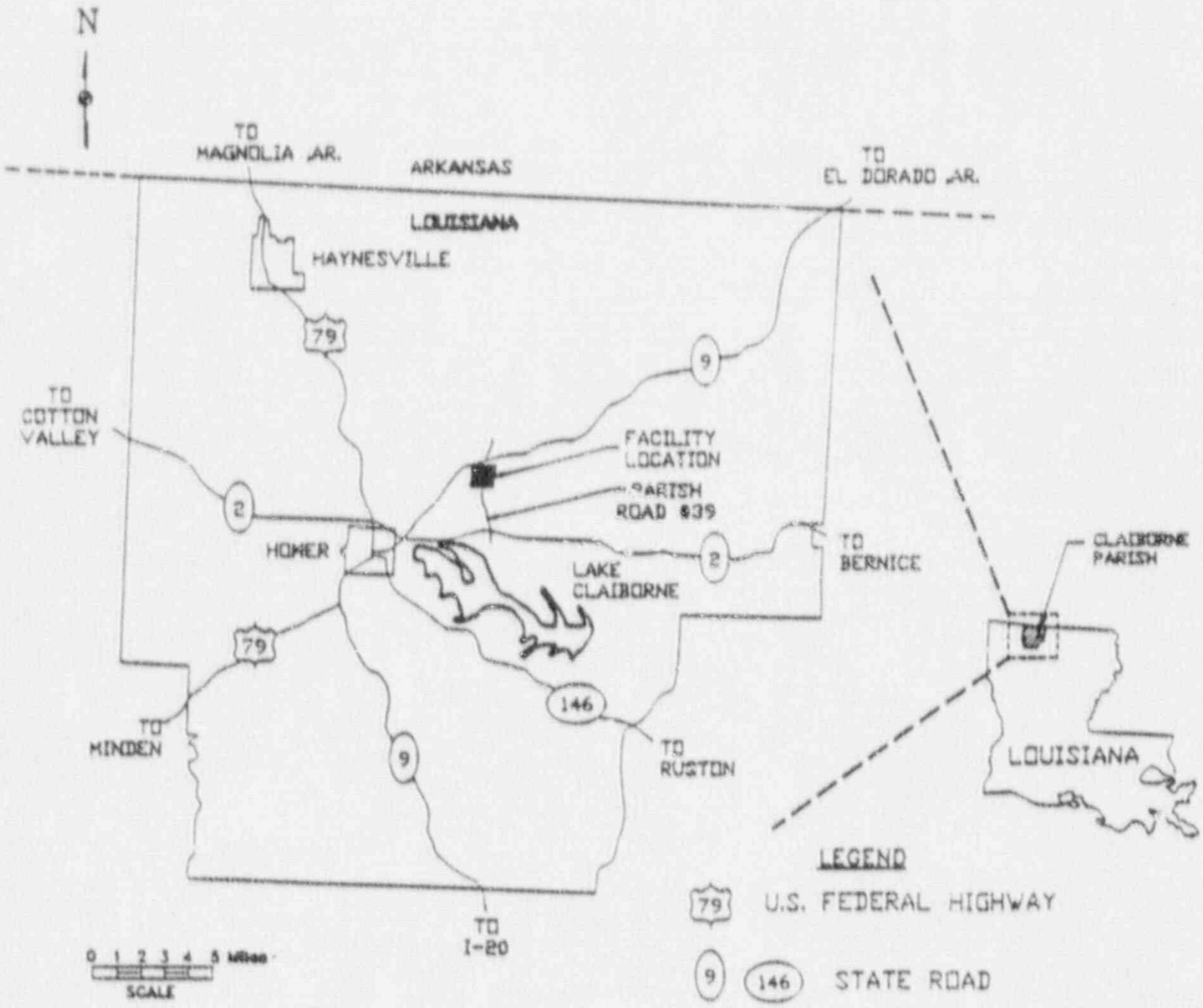
- Le Paz Incorporated, a Minnesota corporation and wholly-owned subsidiary of Graystone Corporatio .

- Micogen Limited III, Inc., a California corporation and wholly-owned subsidiary of FDI.

The applicant is LES. Figure 1.1-2 is an organizational chart for LES.

As part of the separate contracts with LES, Duke Engineering & Services, Inc. (DE&S), a North Carolina corporation and indirect wholly-owned subsidiary of Duke Power, FDI and various Urenco affliates are providing services to LES. DE&S is providing architect/engineer services for the balance of the facility, as well as public outreach, licensing, business office functions and through its parent, Duke Power Company, quality assurance. FDI is providing architect/engineering services, most notably design of the separations building and standby diesel generator systems. BNFL, UCN and Uranit acting through their agent, Centec Gesellschaft fur Centrifugentechnik mbH (Centec), a corporation formed under the laws of the Federal Republic of Germany, have agreed to license certain gas centrifuge uranium enrichment technology to LES. In addition, Urenco, either directly or through various of its affliates, including Centec, will supply the gas centrifuge machines and provide technical support as needed to the two Architect/Engineering firms to ensure the compatibility of the facility design with the Urenco centrifuges.

Several consultants have provided their expertise in support of certain technical studies regarding the facility. Clement Associates, K.S. Crump Division of Ruston, Louisiana was retained to assist in studies of ecology, hydrology, meteorology, environmental monitoring and demography. Duke Power Company of Charlotte, N.C. was retained to perform radiological studies. McDonald-Mehta Engineers of Lubbock, Texas was retained to develop a wind hazard assessment for the facility. Law Engineering of Houston, Texas was retained to perform geotechnical and seismic studies.



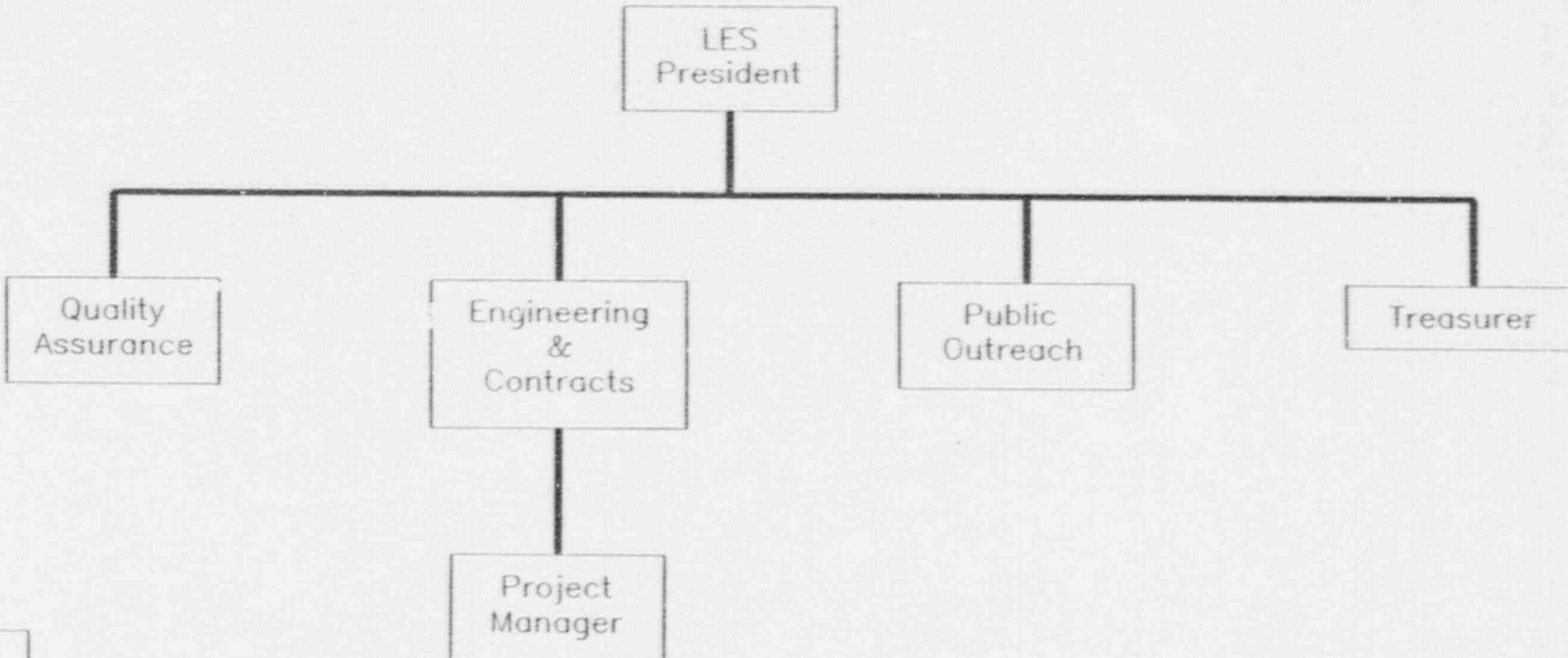
CLAIBORNE PARISH
LOUISIANA

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Facility Location

Figure 1.1-1



CLAIBORNE ENRICHMENT CENTER

LES Organization

Figure 1.1-2

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1.2 NEED FOR FACILITY

The facility will produce uranium enriched in U-235 up to a nominal 5%. The facility will nominally produce 1,500,000 kilograms of separative work per year. This is approximately 15% of the annual separative work needed by domestic nuclear power plants. The separative work requirements for domestic and foreign power plants is outlined in Table 1.2-1. Other potential suppliers of enriched uranium for nuclear power plants are as follows:

a) Eurodif (France) - It is estimated that in 1988 Eurodif supplied approximately 4% of U.S. purchases of uranium enrichment services.

b) Urenco, Ltd. - During 1988 Urenco supplied no enrichment services to U.S. utilities.

c) U.S. Department of Energy (DOE) - It is estimated that in 1988 the DOE supplied approximately 89% of U.S. utility purchases.

d) USSR State Enterprise (Techsnabexport) - In 1988, no enrichment services were supplied directly to U.S. purchases by Techsnabexport. It is possible that such services were supplied indirectly by brokers.

It should be noted that in addition to the above, a number of traders and brokers are actively selling and re-selling excess stocks, over-purchases, and separative work credits obtained from the above producers. This secondary market activity amounted to approximately 7% of U.S. utility purchases in 1988.

There is some indication that enrichment produced by the state-owned enrichment company of the Peoples Republic of China may have been supplied to U.S. customers through the activities of brokers and traders. The extent of this activity is unknown.

Any delay in LES' plans to license and operate the CEC would be very costly. There will be a critical opening in the enrichment market beginning in 1996 because U.S. customers have terminated their commitments for over 40 percent of their enrichment requirements scheduled to be supplied by the Department of Energy during the late 1990's.

Table 1.2-1

World Enrichment Services Requirements Projections
(Millions of SWU)

YEAR	U.S.	WESTERN EUROPE	FAR EAST	OTHER	WOCA* TOTAL	EASTERN EUROPE	USSR	PRC**	WORLD TOTAL
1990	8.52	9.65	3.45	0.26	21.88	0.95	4.05	0.05	26.93
1991	8.47	9.77	3.45	0.26	21.95	1.16	4.32	0.05	27.48
1992	9.66	9.77	3.39	0.26	23.08	1.20	4.53	0.18	28.99
1993	8.40	9.89	3.67	0.26	22.22	1.26	4.80	0.18	28.46
1994	8.55	10.05	3.89	0.26	22.75	1.30	4.96	0.25	29.26
1995	9.47	9.86	3.89	0.26	23.48	1.23	5.03	0.25	29.99
1996	8.52	10.26	4.41	0.26	23.45	1.19	5.22	0.16	30.[illegible]2
1997	8.39	10.38	4.57	0.43	23.77	1.35	5.21	0.16	30.49
1998	9.56	10.63	4.77	0.64	25.60	1.53	5.01	0.16	32.30
1999	8.20	10.61	5.14	0.70	24.65	1.60	5.33	0.33	31.91
2000	8.53	10.60	5.59	0.96	25.68	1.52	5.77	0.33	33.30
2001	9.55	11.07	5.58	0.86	27.06	1.95	5.76	0.23	35.00
2002	8.39	11.05	5.74	0.64	25.82	1.95	5.75	0.23	33.75
2003	8.40	11.11	6.01	0.81	26.33	1.88	5.63	0.23	34.07
2004	9.92	11.58	6.59	0.81	28.90	1.88	5.76	0.41	36.95
2005	8.71	12.12	6.63	0.71	28.17	1.97	5.99	0.41	36.54
2006	8.85	12.24	6.43	0.71	28.23	2.15	6.12	0.48	36.98
2007	9.92	12.03	6.58	0.70	29.23	2.25	6.27	0.49	38.24
2008	9.11	12.41	6.52	0.91	28.95	2.51	6.18	0.34	37.98
2009	9.10	12.62	6.78	0.92	29.42	2.45	6.30	0.57	38.74
2010	10.27	12.36	7.16	0.80	30.59	2.28	6.50	0.57	39.94

* WOCA (World Outside Centrally Planned Economic Areas)

** PRC (People's Republic of China)

NOTE: Requirements for Western Europe include 600,000 SWU used annually by the United Kingdom to recycle depleted uranium from spent Magnox fuel to serve as natural feed for Advanced Gas Cooled Reactor requirements.

Source: Energy Resources International, Inc., 1990.

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1.3 PROPOSED PROJECT SCHEDULE

The following dates are the milestones for facility construction and operation:

January, 1991 - Submit facility license application to the Nuclear Regulatory Commission.

February, 1993 - Initiate facility construction.

October, 1995 - Commence production of enriched uranium.

December, 1997 - Achieve full nominal production output of 1.5 million separative work units per year.

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1.4 DRAWING SYMBOLS

This Environmental Report (ER) contains a number of schematic drawings. These drawings make use of many symbols which are not considered industry standard. Figures 1.4-1 through 1.4-3 contain legends of the various drawing symbols utilized by Fluor Daniel (FDI) and Duke Engineering & Services (DE&S) in preparation of the various schematic drawings found in the ER.

Flow diagrams prepared by both FDI and DESI are included as figures in this ER. Figure 1.4-1 should be used in interpreting flow diagram figures that bear the FDI logo. Figure 1.4-2 should be used in interpreting all other flow diagram figures. Figure 1.4-3 should be used in interpreting electrical drawings.

PIPE LINE SERVICE ABBREVIATIONS

PROCESS AND UTILITIES

F	—	FEED
P	—	PRODUCT
T	—	TAILS
V	—	VENT
ATA	—	ATMOSPHERIC AIR
IA	—	INSTRUMENT AIR
PA	—	PLANT AIR
CWR	—	COOLING WATER RETURN
CWS	—	COOLING WATER SUPPLY
DW	—	DEMINERALIZED WATER
MCWR	—	MACHINE COOLING WATER RETURN
MCWS	—	MACHINE COOLING WATER SUPPLY
PW	—	POTABLE WATER
SCWR	—	SPRAY COOLING WATER RETURN
SCWS	—	SPRAY COOLING WATER SUPPLY
UW	—	UTILITY WATER SUPPLY
W	—	WELL
CRR	—	COLD REFRIGERANT RETURN
CRS	—	COLD REFRIGERANT SUPPLY
HRR	—	HOT REFRIGERANT RETURN
HRS	—	HOT REFRIGERANT SUPPLY
LN	—	LIQUID NITROGEN
N	—	NITROGEN
NG	—	NATURAL GAS
CD	—	CHEMICAL DRAIN
DR	—	CLEAN DRAIN
SS	—	SANITARY SEWER
HYD	—	HYDRAULIC FLUID
LUB	—	LUBRICANT

HVAC

CHWR	—	CHILLED WATER RETURN
CHWS	—	CHILLED WATER SUPPLY
HWR	—	HOT WATER RETURN
HWS	—	HOT WATER SUPPLY

FIRE PROTECTION

FW	—	FIRE WATER

EQUIPMENT IDENTIFICATION CODE

SYMBOL		EQUIPMENT
AC	—	AIR CONDITIONING UNIT
AG	—	AGITATOR
AH	—	AIR HANDLING UNIT
AU	—	AUTOCLAVE
BD	—	BACKDRAFT DAMPER
BL	—	BLOWER, FAN
BV	—	BUTTERFLY VALVE DAMPER
C	—	COMPRESSOR
CC	—	HVAC COOLING COIL
CD	—	CONTROL DAMPER
CE	—	CENTRIFUGE
CH	—	CHLORINATOR
CO	—	COMPUTER
CP	—	CONTROL PANEL
CRT	—	CATHODE RAY TUBE
CS	—	CYLINDER STATION
CT	—	COOLING TOWER
CY	—	CYCLONE
DE	—	DEMISTER
DF	—	DIFFUSER
DM	—	DEMINERALIZER
DP	—	DISPLAY PROCESSOR
DR	—	DRYER
DS	—	DESUBLIMER
E	—	COOLER, HEAT EXCHANGER, VAPORIZER
EJ	—	EJECTOR, EXHAUSTER
F	—	FILTER
FD	—	FIRE DAMPER
FDR	—	FILTER/DRYER
FH	—	FILTER, HEPA (HVAC)
G	—	GENERATOR
H	—	HEATER, FURNACE
HC	—	HEATING COIL
HP	—	HEALTH PROTECTION SENSORS AND SYSTEM
HU	—	HUMIDIFIER
ID	—	ISOLATION DAMPER
IR	—	INSTRUMENT RACK
KB	—	KEYBOARD
LP	—	LOCAL PANEL
M	—	MOTOR
MCC	—	MOTOR CONTROL CENTER
MD	—	MANUAL DAMPER
ME	—	MISCELLANEOUS MECHANICAL EQUIPMENT
MU	—	MULTIPLEXER
MX	—	MIXER, BLENDER
P	—	PUMP
PR	—	PRINTER
RE	—	REFRIGERATION UNIT
S	—	SCALE
SE	—	SEPARATOR, CYCLONE, COALESCER, CLARIFIER, DUST COLLECTOR
SI	—	MUFFLER, SILENCER
SK	—	SCRUBBER
SR	—	STORAGE RACK
SU	—	SUMP
TD	—	TORNADO DAMPER
TK	—	TANK
UP	—	UNINTERRUPTIBLE POWER SUPPLY EQUIPMENT
V	—	VESSEL, ACCUMULATOR, COLUMN, DRUM, POT, RECEIVER, TOWER
VP	—	VACUUM PUMP
VR	—	VAPOR RECOVERY
WS	—	WATER SOFTENER
XT	—	TRANSFORMER

SYSTEM NUMBERS

PLANT LAYOUT/GENERAL – SYSTEM 100

CENTRIFUGES – SYSTEM 200

CASCADES – SYSTEM 300

360 — CENTRIFUGE ENRICHMENT

UF6 SYSTEMS – SYSTEM 400

410	—	UF_6 FEED
420	—	PRODUCT TAKE-OFF
430	—	TAILS TAKE-OFF
450	—	CONTINGENCY DUMP
460	—	PRODUCT BLENDING
470	—	PRODUCT LIQUID SAMPLING
490	—	PORTABLE TEST EQUIPMENT

INSTRUMENTATION – SYSTEM 500

510	—	CONTROL ROOM PANEL AND COMPUTER
520	—	PLANT INSTRUMENTATION (HEX)
530	—	PLANT INSTRUMENTATION (NON-HEX)
540	—	BUILDING SERVICES INCLUDING SAFETY

GENERAL SERVICES – SYSTEM 600

610	—	COOLING WATER SYSTEMS
611	—	MAIN PLANT COOLING WATER
612	—	MACHINE COOLING WATER
613	—	DEMINERALIZED WATER STORAGE
617	—	SPRAY COOLING WATER
618	—	AIR COOLING PRODUCT CONTAINERS
619	—	AIR COOLING BLENDING CONTAINERS
620	—	REFRIGERANT SYSTEMS
621	—	HOT REFRIGERANT HEATING
622	—	HOT REFRIGERANT DISTRIBUTION
625	—	COLD REFRIGERANT CHILLERS
626	—	COLD REFRIGERANT DISTRIBUTION
629	—	REFRIGERANT FILLING AND STORAGE
630	—	COMPRESSED AIR SYSTEMS
631	—	PLANT/INSTRUMENT AIR
640	—	NITROGEN
650	—	HOT WATER (HVAC AND DOMESTIC HOT
660	—	SEWAGE TREATMENT SYSTEMS
661	—	LIQUID EFFLUENT DISCHARGE
662	—	DECONTAMINATION
663	—	CONTAMINATED LAUNDRY
664	—	LIQUID WASTE DISPOSAL
665	—	LIQUID EFFLUENT MONITORING
666	—	SOLID WASTE DISPOSAL
667	—	FOMBLIN OIL RECOVERY
670	—	HVAC SYSTEMS
671	—	H & V (CASCADE HALLS)
672	—	H & V (ASSAY SERVICES CORRIDORS)
673	—	H & V (UF_6 BUILDING)
674	—	H & V (AUXILIARY AREAS)
675	—	H & V (CONTAINER PREPARATION, CON LING, AND BLENDING)
676	—	H & V (CONTROL AND ADMINISTRATION
677	—	H & V (SUPPORT AREA)
678	—	GASEOUS EFFLUENT VENT SYSTEM
680	—	HOISTING/TRANSPORTATION EQUIPMENT
690	—	UTILITIES
691	—	UTILITY/POTABLE WATER
693	—	FIRE WATER

ELECTRICAL – SYSTEM 700

740	—	MEDIUM FREQUENCY DRIVE SYSTEM
741	—	CENTRIFUGE MONITORING SYSTEM
742	—	CASCADE PROTECTION EQUIPMENT
750	—	STANDBY GENERATOR
760	—	UPS SYSTEM
770	—	TRACE HEATING

YSTEMS

WATER)

AINER HAND-
AREA)

PIPE LINE IDENTIFICATION

TO BE COMPLETED DURING PHASE III (DETAILED DESIGN) OF THE CONTRACT.

EQUIPMENT NUMBERING

X-XXX-XX-XXX-A-M

- M — MOTOR DESIGNATION
- A — QUANTITY IDENTIFIER, APPLICABLE WHEN THERE IS MORE THAN ONE UNIT. USE "A" FOR FIRST UNIT, "B" FOR SECOND UNIT, ETC.
- XXX — EQUIPMENT TAG NUMBERING
- XX — EQUIPMENT IDENTIFICATION CODE
- XXX — SYSTEM NUMBER
- X — PLANT UNIT (1, 2, 3, OR G)

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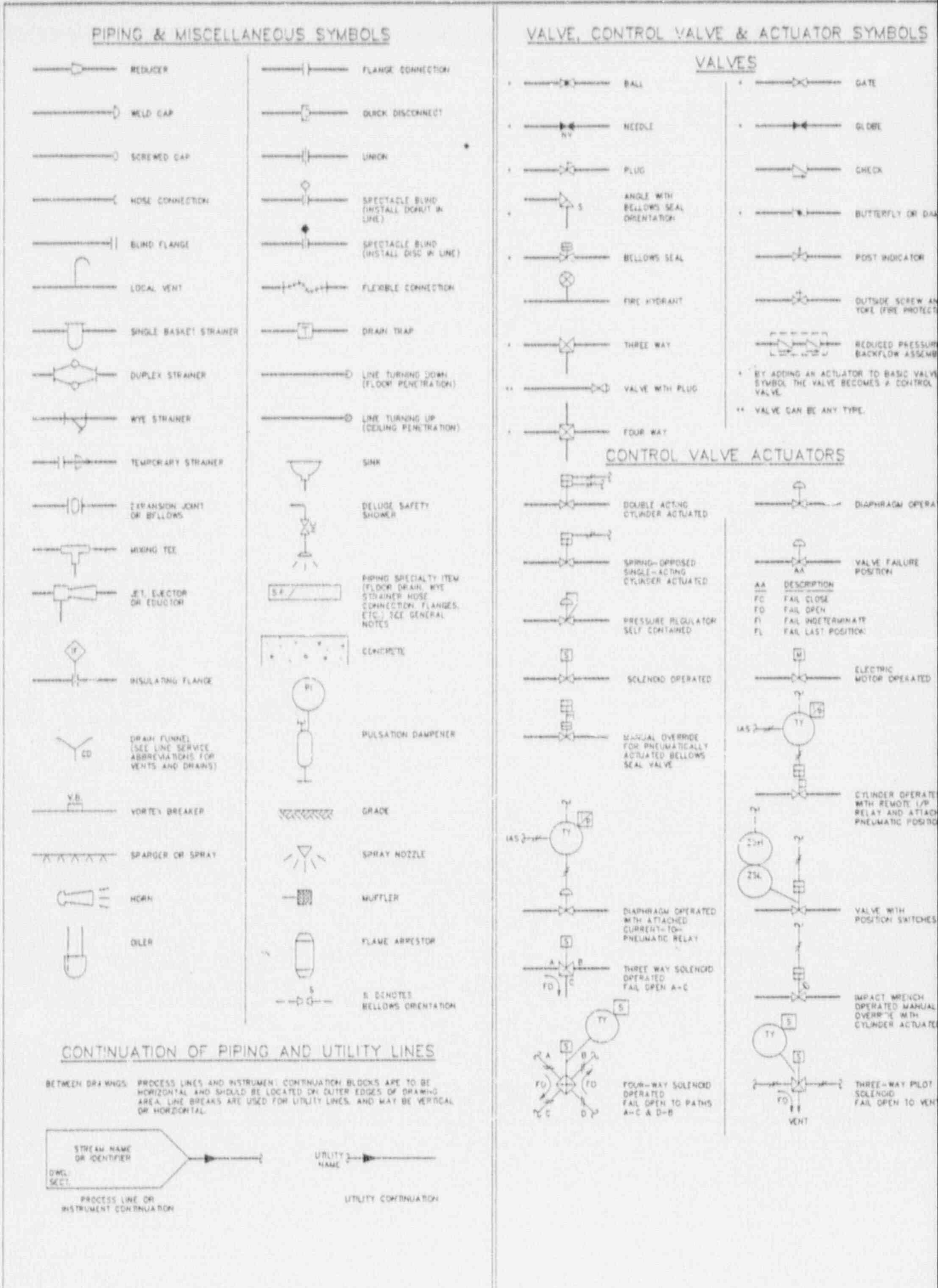
FLUOR DANIEL

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

LEGEND OF SYMBOLOGY FOR
FLOW DIAGRAMS -- FDI

Figure 1.4-1

ACAD DF=ER141


PIPING & MISCELLANEOUS SYMBOLS
REDUCER
WELD CAP
SCREWED CAP
HOSE CONNECTION
BLIND FLANGE
LOCAL VENT
SINGLE BASKET STRAINER
DUPLEX STRAINER
WYE STRAINER
TEMPORARY STRAINER
EXPANSION JOINT OR BELLOWS
MIXING TEE
JET, EJECTOR OR EDUCTOR
INSULATING FLANGE
IF
DRAIN FUNNEL (SEE LINE SERVICE ABBREVIATIONS FOR VENTS AND DRAINS)
ED
V.B.
VORTEX BREAKER
SPARGER OR SPRAY
HORN
OILER
FLANGE CONNECTION
QUICK DISCONNECT
UNION
SPECTACLE BLIND (INSTALL DONUT IN LINE)
SPECTACLE BLIND (INSTALL DISC IN LINE)
FLEXIBLE CONNECTION
DRAIN TRAP
T
LINE TURNING DOWN (FLOOR PENETRATION)
LINE TURNING UP (CEILING PENETRATION)
SINK
DELUGE SAFETY SHOWER
S.P.
PIPING SPECIALTY ITEM (FLOOR DRAIN, WYE STRAINER HOSE CONNECTION, FLANGES, ETC.) SEE GENERAL NOTES
CONCRETE
PI
PULSATION DAMPENER
GRADE
SPRAY NOZZLE
MUFFLER
FLAME ARRESTOR
S
S DENOTES BELLOWS ORIENTATION
CONTINUATION OF PIPING AND UTILITY LINES
BETWEEN DRAWINGS: PROCESS LINES AND INSTRUMENT CONTINUATION BLOCKS ARE TO BE HORIZONTAL AND SHOULD BE LOCATED ON OUTER EDGES OF DRAWING AREA. LINE BREAKS ARE USED FOR UTILITY LINES, AND MAY BE VERTICAL OR HORIZONTAL.
STREAM NAME OR IDENTIFIER
DWG. SECT.
PROCESS LINE OR INSTRUMENT CONTINUATION
UTILITY NAME
UTILITY CONTINUATION
VALVE, CONTROL VALVE & ACTUATOR SYMBOLS
VALVES
BALL
NEEDLE
NV
PLUG
ANGLE WITH BELLOWS SEAL ORIENTATION
S
BELLOWS SEAL
FIRE HYDRANT
THREE WAY
VALVE WITH PLUG
FOUR WAY
GATE
GLOBE
CHECK
BUTTERFLY OR DA
POST INDICATOR
OUTSIDE SCREW AN YOKE (FIRE PROTECT
REDUCED PRESSUR BACKFLOW ASSEMB
* BY ADDING AN ACTUATOR TO BASIC VALVE SYMBOL THE VALVE BECOMES A CONTROL VALVE.
** VALVE CAN BE ANY TYPE.
CONTROL VALVE ACTUATORS
DOUBLE ACTING CYLINDER ACTUATED
SPRING-OPPOSED SINGLE-ACTING CYLINDER ACTUATED
PRESSURE REGULATOR SELF CONTAINED
S
SOLENOID OPERATED
MANUAL OVERRIDE FOR PNEUMATICALLY ACTUATED BELLOWS SEAL VALVE
IAS
TY
I/P
DIAPHRAGM OPERATED WITH ATTACHED CURRENT-TO-PNEUMATIC RELAY
A
B
C
FO
THREE WAY SOLENOID OPERATED FAIL OPEN A-C
D
FOUR-WAY SOLENOID OPERATED FAIL OPEN TO PATHS A-C & D-B
DIAPHRAGM OPERA
AA
VALVE FAILURE POSITION
AA DESCRIPTION
FC FAIL CLOSE
FO FAIL OPEN
FI FAIL INDETERMINATE
FL FAIL LAST POSITION
M
ELECTRIC MOTOR OPERATED
CYLINDER OPERATE WITH REMOTE I/P RELAY AND ATTACH PNEUMATIC POSITIO
ZSH
ZSL
VALVE WITH POSITION SWITCHES
IMPACT WRENCH OPERATED MANUAL OVERRIDE WITH CYLINDER ACTUATE
THREE-WAY PILOT SOLENOID FAIL OPEN TO VENT
VENT

PIPING LINE SYMBOLS

- PRINCIPAL FLOW/PROCESS LINE (WT 3)
- ALTERNATE FLOW/UTILITY LINE (WT 2)
- INSTRUMENT LINE (WT 1)
- MECHANICAL TRANSFER PATH (WT 4)
- REFERENCE SYSTEM/PHANTOM LINE, TO CLARIFY OR SIMPLIFY ROUTING OF PROCESS FLOW LINES. SOME PIECES OF EQUIPMENT MAY APPEAR IN MORE THAN ONE PLACE ON THE DIAGRAM. EQUIPMENT SO DUPLICATED WILL BE INDICATED BY PHANTOM LINE.
- ET — HEATED PIPE, ET = ELECTRICAL TRACING
- C | A — PIPE CLASS CHANGE
- FLUOR DANIEL | DESI — RESPONSIBILITY
- BOUNDARY OF FURNISHED EQUIPMENT
- BOUNDARY OF REPLICATED EQUIPMENT
- BURIED PIPE (UNDERGROUND)
- ENCASED LINES

INSTRUMENT AND ELECTRICAL LINES

- ELECTRICAL SIGNAL
- PNEUMATIC SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- HYDRAULIC SIGNAL
- ELECTROMAGNETIC, SONIC OR OPTICAL SIGNAL
- INTERNAL SYSTEM LINK (SOFTWARE)

9102060114-02

ABBREVIATIONS AND ACRONYMS

AI — ANALOG INPUT
AMB — AMBIENT
ATMOS — ATMOSPHERE
AO — ANALOG OUTPUT

BD — BLOWDOWN OR BACKDRAFT DAMPER
BLDG — BUILDING

CCR — CENTRAL CONTROL ROOM
CCTV — CLOSED CIRCUIT TELEVISION
CSC — CAR SEAL CLOSE
CSO — CAR SEAL OPEN
CMS — CENTRIFUGE MONITORING SYSTEM

DAS — DATA ACQUISITION SYSTEM
DCS — DISTRIBUTED CONTROL SYSTEM
DECON — DECONTAMINATION
DESI — DUKE ENGINEERING AND SERVICES INC.
DI — DIGITAL INPUT
DO — DIGITAL OUTPUT

EFF — EFFICIENCY
EL — ELECTRICAL (HVAC HEATERS ONLY)
ELEC — ELECTRICAL
ET — ELECTRIC TRACED
EXH — EXHAUST

(F) — VENDOR FURNISHED
FC — FAIL CLOSED
FDI — FLUOR DANIEL INC
FI — FAIL INDETERMINATE
FL — FAIL LAST POSITION
FO — FAIL OPEN
(F & P) — VENDOR FURNISHED AND PIPED
FP — FULL PORT

GA — GAUGE

HEPA — HIGH EFFICIENCY PARTICULATE AIR
HEX — URANIUM HEXAFLUORIDE
HLL — HIGH LIQUID LEVEL
HHLL — HIGH HIGH LIQUID LEVEL
HOA — HAND-OFF-AUTO
HP — HORSE POWER OR HIGH PRESSURE
HPT — HIGH POINT
HTG — HEATING
HVAC — HEATING, VENTILATION AND AIR CONDITIONING

IAS — INSTRUMENT AIR SUPPLY
IC — INSULATION COLD
ID — INSIDE DIAMETER
IH — INSULATION HOT
INC — INSULATION ACOUSTIC
I/O — INPUT/OUTPUT
IS — INSULATION SAFETY

LC — LOCK CLOSED
LES — LOUISIANA ENERGY SERVICES
LLL — LOW LIQUID LEVEL
LLLL — LOW LOW LIQUID LEVEL
LO — LOCK OPEN
LP — LOW PRESSURE OR LOCAL PANEL
LPT — LOW POINT

NC — NORMALLY CLOSED
NLL — NORMAL LIQUID LEVEL
NO — NORMALLY OPEN
NRC — NUCLEAR REGULATORY COMMISSION

OAX — OUTSIDE AIR INTAKE
OD — OUTSIDE DIAMETER

PO — PUMP OUT

SC — SAMPLE CONNECTION
SG — SPECIFIC GRAVITY
SP — SET POINT
SPLY — SUPPLY

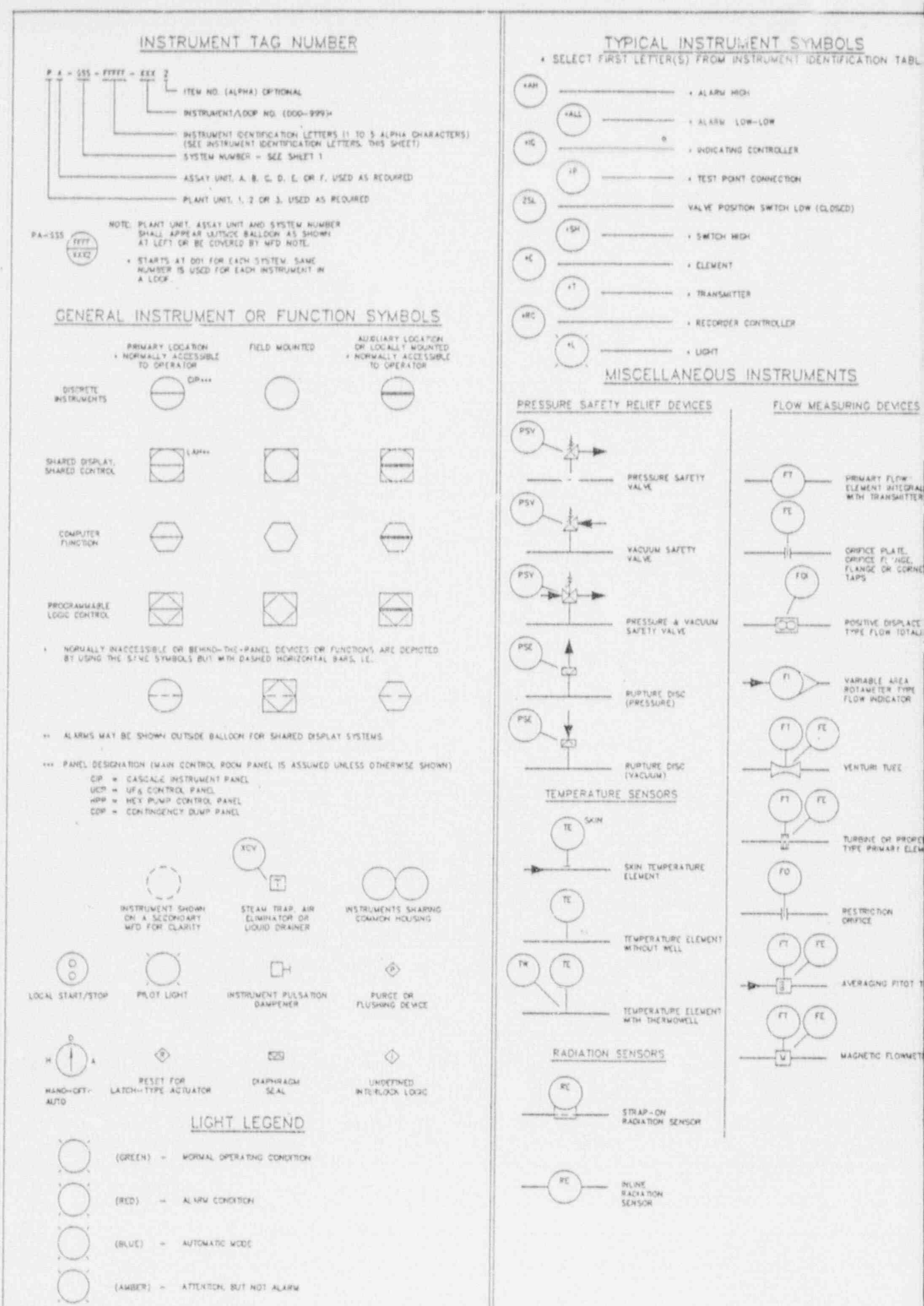
TC — TEST CONNECTION
TSO — TIGHT SHUT OFF
T/T — TANGENT-TO-TANGENT
TYP — TYPICAL

UPS — UNINTERRUPTIBLE POWER SUPPLY

VAC — VACUUM

WC — WATER COLUMN

Figure 1.4-1		
DRAWING NO.	REV.	FRAME
C-000-0001	0	2 OF 4


INSTRUMENT TAG NUMBER
P A - SSS - FFFFF - XXX Z
ITEM NO. (ALPHA) OPTIONAL
INSTRUMENT/LOOP NO. (000-999)*
INSTRUMENT IDENTIFICATION LETTERS (1 TO 5 ALPHA CHARACTERS)
(SEE INSTRUMENT IDENTIFICATION LETTERS, THIS SHEET)
SYSTEM NUMBER - SEE SHEET 1
ASSAY UNIT, A, B, C, D, E, OR F, USED AS REQUIRED
PLANT UNIT, 1, 2 OR 3, USED AS REQUIRED
NOTE: PLANT UNIT, ASSAY UNIT AND SYSTEM NUMBER SHALL APPEAR OUTSIDE BALLOON AS SHOWN AT LEFT OR BE COVERED BY MFD NOTE.
PA-SSS
FFFF
XXXZ
* STARTS AT 001 FOR EACH SYSTEM. SAME NUMBER IS USED FOR EACH INSTRUMENT IN A LOOP.
GENERAL INSTRUMENT OR FUNCTION SYMBOLS
PRIMARY LOCATION * NORMALLY ACCESSIBLE TO OPERATOR
FIELD MOUNTED
AUXILIARY LOCATION OR LOCALLY MOUNTED * NORMALLY ACCESSIBLE TO OPERATOR
DISCRETE INSTRUMENTS
CIP***
SHARED DISPLAY, SHARED CONTROL
LAH**
COMPUTER FUNCTION
PROGRAMMABLE LOGIC CONTROL
* NORMALLY INACCESSIBLE OR BEHIND-THE-PANEL DEVICES OR FUNCTIONS ARE DEPICTED BY USING THE SAME SYMBOLS BUT WITH DASHED HORIZONTAL BARS, I.E.
** ALARMS MAY BE SHOWN OUTSIDE BALLOON FOR SHARED DISPLAY SYSTEMS.
*** PANEL DESIGNATION (MAIN CONTROL ROOM PANEL IS ASSUMED UNLESS OTHERWISE SHOWN)
CIP = CASCADE INSTRUMENT PANEL
UCP = UF6 CONTROL PANEL
HPP = HEX PUMP CONTROL PANEL
CDP = CONTINGENCY DUMP PANEL
XCV
T
INSTRUMENT SHOWN ON A SECONDARY MFD FOR CLARITY
STEAM TRAP, AIR ELIMINATOR OR LIQUID DRAINER
INSTRUMENTS SHARING COMMON HOUSING
LOCAL START/STOP
PILOT LIGHT
INSTRUMENT PULSATION DAMPENER
PURGE OR FLUSHING DEVICE
P
H
O
A
HAND-OFF-AUTO
R
RESET FOR LATCH-TYPE ACTUATOR
DIAPHRAGM SEAL
I
UNDEFINED INTERLOCK LOGIC
LIGHT LEGEND
(GREEN) - NORMAL OPERATING CONDITION
(RED) - ALARM CONDITION
(BLUE) - AUTOMATIC MODE
(AMBER) - ATTENTION, BUT NOT ALARM
TYPICAL INSTRUMENT SYMBOLS
* SELECT FIRST LETTER(S) FROM INSTRUMENT IDENTIFICATION TABL
*AH
* ALARM HIGH
*ALL
* ALARM LOW-LOW
*IC
* INDICATING CONTROLLER
*P
* TEST POINT CONNECTION
ZSL
VALVE POSITION SWITCH LOW (CLOSED)
*SH
* SWITCH HIGH
*E
* ELEMENT
*T
* TRANSMITTER
*RC
* RECORDER CONTROLLER
*L
* LIGHT
MISCELLANEOUS INSTRUMENTS
PRESSURE SAFETY RELIEF DEVICES
PSV
PRESSURE SAFETY VALVE
PSV
VACUUM SAFETY VALVE
PSV
PRESSURE & VACUUM SAFETY VALVE
PSE
RUPTURE DISC (PRESSURE)
PSE
RUPTURE DISC (VACUUM)
TEMPERATURE SENSORS
TE
SKIN
SKIN TEMPERATURE ELEMENT
TE
TEMPERATURE ELEMENT WITHOUT WELL
TW
TE
TEMPERATURE ELEMENT WITH THERMOWELL
RADIATION SENSORS
RE
STRAP-ON RADIATION SENSOR
RE
INLINE RADIATION SENSOR
FLOW MEASURING DEVICES
FT
PRIMARY FLOW ELEMENT INTEGRAL WITH TRANSMITTER
FE
ORIFICE PLATE, ORIFICE FLANGE, FLANGE OR CORNE TAPS
FQI
POSITIVE DISPLACE TYPE FLOW TOTALI
FI
VARIABLE AREA ROTAMETER TYPE FLOW INDICATOR
FT
FE
VENTURI TUBE
FT
FE
TURBINE OR PROPE TYPE PRIMARY ELEM
FO
RESTRICTION ORIFICE
FT
FE
AVERAGING PITOT T
FT
FE
M
MAGNETIC FLOWMET

INSTRUMENT IDENTIFICATION LETTERS

INSTRUMENT IDENTIFICATION AND SYMBOLS ARE BASED ON INSTRUMENT SOCIETY OF AMERICA STANDARD S5 1 - 1984

	FIRST - LETTER		SUCCEEDING - LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS *		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY			CONTROLLER	
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	GAGING		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE OR HUMIDITY	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE TOTALIZE			
R	RADIOACTIVITY		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED		UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE			RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION			DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

NOTE: REFER TO ISA STANDARDS FOR FURTHER INFORMATION.

* SPECIFIC ANALYSIS INFORMATION IS SHOWN OUTSIDE INSTRUMENT BALLOON AS FOLLOWS:

AT — AAA

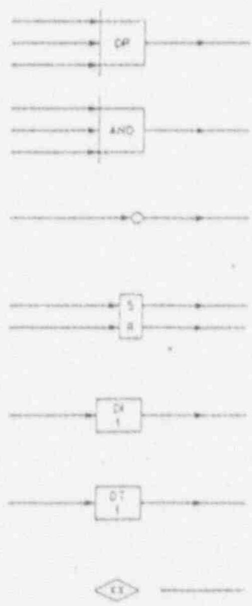
AAA		DESCRIPTION
CO	=	CARBON MONOXIDE
CO_2	=	CARBON DIOXIDE
COMB	=	COMBUSTIBLES
H_2	=	HYDROGEN
O_2	=	OXYGEN
pH	=	pH
HF	=	HYDROGEN FLUORIDE
UF_6	=	URANIUM HEXAFLUORIDE

FUNCTION IDENTIFICATION

- = ANALOG/DIGITAL
- = INVERSE DERIVATIVE
- = DERIVATIVE OR RATE
- = HIGH - SELECTOR
- = LOW - SELECTOR
- = SUM
- = BIAS
- = DIVIDE
- = AVERAGE
- = CHARACTERIZE
- = TIME FUNCTION
- = RAISE TO POWER
- = EXTRACT SQUARE ROOT
- = BOOST
- = ON - OFF
- = SOLENOID
- = DIFFERENCE
- = GAIN
- = REVERSE
- = MULTIPLY
- = INTEGRATE
- = PROPORTIONAL
- = FOR INPUT/OUTPUT OF THE FOLLOWING (EXAMPLE SHOWN IS CURRENT TO PNEUMATIC)

DESIGNATION	SIGNAL
E	VOLTAGE
H	HYDRAULIC
I	CURRENT
O	ELECTROMAGNETIC SONIC SIGNAL OR LIGHT BEAM
P	PNEUMATIC
R	RESISTANCE

LOGIC SYMBOLS



OR = OUTPUT EXISTS IF ONE OR MORE OF THE INPUTS EXIST

AND = OUTPUT EXISTS IF AND ONLY IF ALL THE INPUTS EXIST

NOT = NO OUTPUT EXISTS IF AN INPUT EXISTS

MEMORY FLIP-FLOP

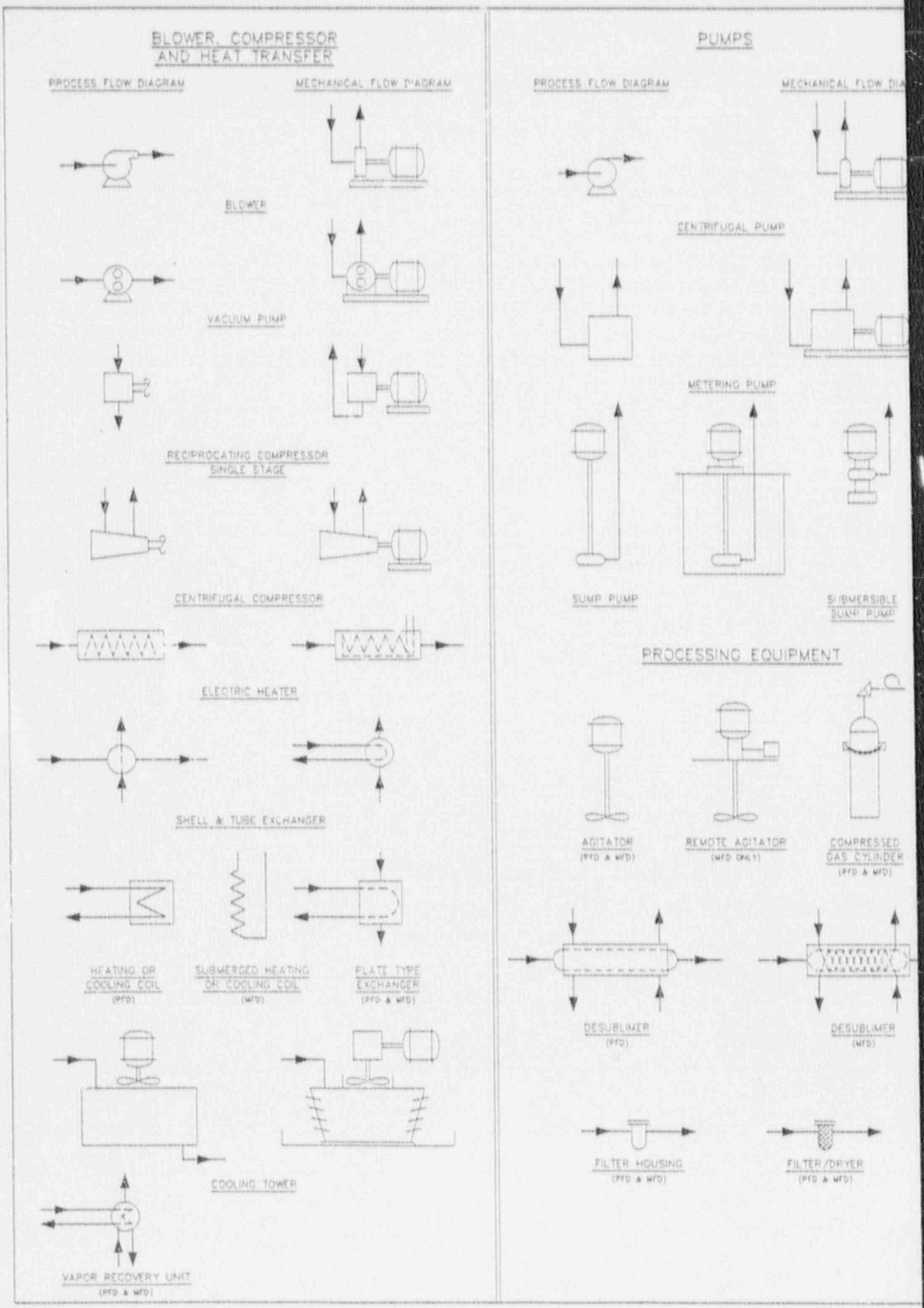
DELAY INITIATION OF OUTPUT (t = DELAY TIME)

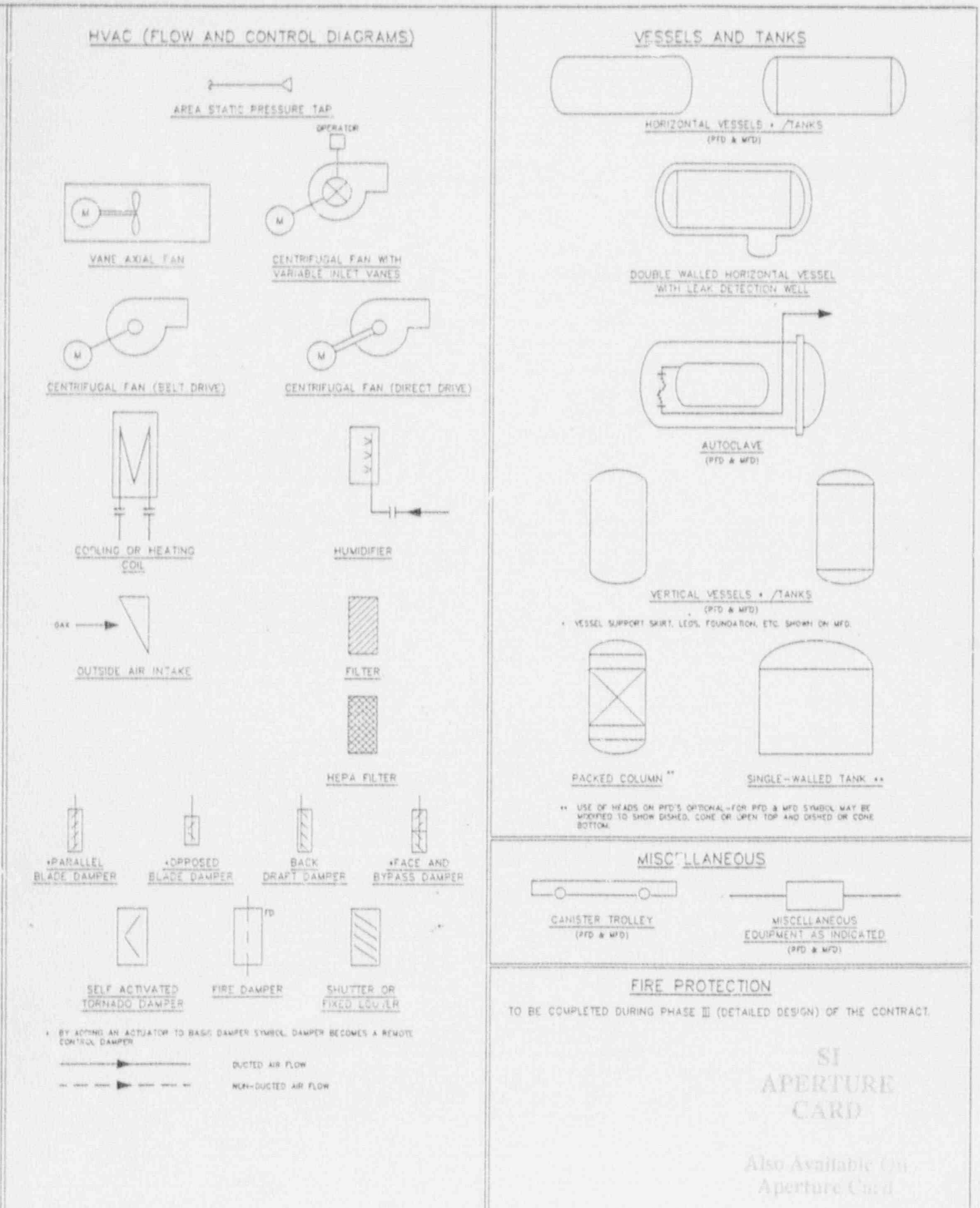
DELAY TERMINATION OF OUTPUT (t = DELAY TIME)

INDICATES DWG. NO. FOR LOGIC DIAGRAM OR ELECTRICAL ELEMENTARY DRAWING

9102060114-03

Figure 1.4-1		
DRAWING NO.	REV.	FRAME
G-000-0001	0	3 OF 4

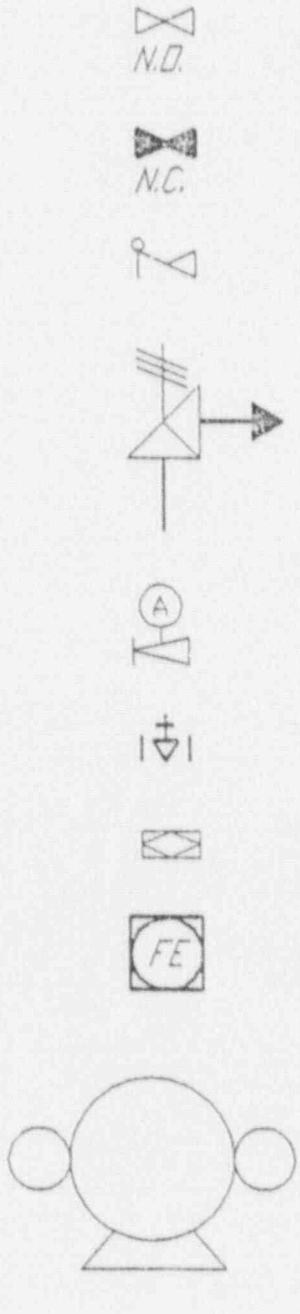

BLOWER, COMPRESSOR AND HEAT TRANSFER
PROCESS FLOW DIAGRAM
MECHANICAL FLOW DIAGRAM
BLOWER
VACUUM PUMP
RECIPROCATING COMPRESSOR SINGLE STAGE
CENTRIFUGAL COMPRESSOR
ELECTRIC HEATER
SHELL & TUBE EXCHANGER
HEATING OR COOLING COIL (PFD)
SUBMERGED HEATING OR COOLING COIL (MFD)
PLATE TYPE EXCHANGER (PFD & MFD)
COOLING TOWER
VAPOR RECOVERY UNIT (PFD & MFD)
PUMPS
PROCESS FLOW DIAGRAM
CENTRIFUGAL PUMP
METERING PUMP
SUMP PUMP
SUBMERSIBLE SUMP PUMP
PROCESSING EQUIPMENT
AGITATOR (PFD & MFD)
REMOTE AGITATOR (MFD ONLY)
COMPRESSED GAS CYLINDER (PFD & MFD)
DESUBLIMER (PFD)
DESUBLIMER (MFD)
FILTER HOUSING (PFD & MFD)
FILTER/DRYER (PFD & MFD)



9102060114 - 04

Figure 1.4-1		
DRAWING NO.	REV.	FRAME
G-000-0001	0	4 OF 4

SYMBOL



GATE VALVE

GATE VALVE

SWING CHECK VALVE

RELIEF VALVE

ALARM CHECK VALVE

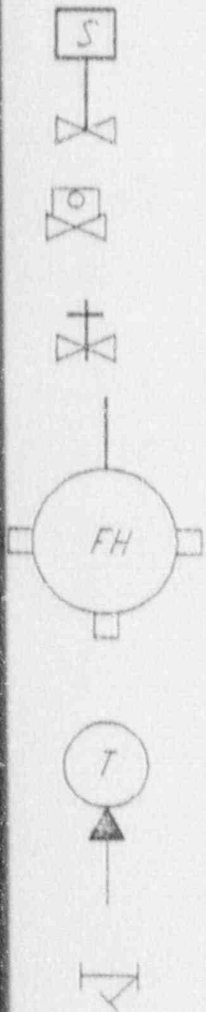
COCK VALVE

DELUGE VALVE

FLOW ELEMENT

PUMP

LEGEND



SOLENOID OPERATED VALVE

POST INDICATOR

INDICATING STEM (DS & ?)

FIRE HYDRANT

TELL-TALE WATER LEVEL INDICATOR

Y - STRAINER

9102060114-05

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

LEGEND OF SYMBOLOGY FOR
FLOW DIAGRAMS – DESI

Figure 1.4-2

ACAD DF-H05AR038

ONE LINE	3-LINES, SCHEMATIC, & CONNECTION DIAGRAM	USED FOR	REMARKS
		FUSE	SHOW AMPERE RATING
		FUSED DISCONNECT SWITCH	SHOW AMPERE RATING
		ISOLATING FUSE-SWITCH: HIGH VOLTAGE PRIMARY FUSE CUTOUT, DRY TYPE	HOOK STICK. SHOW AMPERE RATING
		HIGH VOLTAGE PRIMARY FUSE CUTOUT, OIL TYPE	SHOW AMPERE RATING AND INTERRUPTING CAPACITY
		AIR CIRCUIT BREAKER	TRIP SETTING AND FRAME SIZE TO BE INDICATED
		3-POLE CIRCUIT BREAKER WITH THERMAL-OVERLOAD DEVICE IN ALL 3 POLES	TRIP SETTING AND FRAME SIZE TO BE INDICATED
		3-POLE CIRCUIT BREAKER WITH MAGNETIC-OVERLOAD DEVICE IN ALL 3 POLES	TRIP SETTING AND FRAME SIZE TO BE INDICATED
		PLUG IN TYPE EQUIPMENT	CIRCUIT BREAKERS AND COMBINATION STARTERS IN MOTOR CONTROL CENTERS
		DRAW-OUT DEVICE	ARROW IS ON REMOVABLE ELEMENT, USUALLY WITH MAJOR EQUIPMENT SUCH AS DRAW-OUT TYPE SWITCHGEAR
400:5 A	400:5 A	CURRENT TRANSFORMER	SQUARES ON LINES ARE POLARITY MARKS. SHOW WINDING RATIOS ONLY ONCE PER CIRCUIT
400:5:5 A	400:5:5 A	DUAL SECONDARY CURRENT TRANSFORMER	SQUARES ON LINES ARE POLARITY MARKS. SHOW WINDING RATIOS ONLY ONCE PER CIRCUIT
400:5 A	400:5 A	BUSHING TYPE CURRENT TRANSFORMER	SQUARES ON LINES ARE POLARITY MARKS. SHOW WINDING RATIOS ONLY ONCE PER CIRCUIT
		POTENTIAL (VOLTAGE) TRANSFORMER	SQUARES ON LINES ARE POLARITY MARKS. SHOW WINDING RATIOS ONLY ONCE PER CIRCUIT
4160-480Y/277 V	SEE MANUFACTURER'S CONNECTION DIAGRAM	POWER TRANSFORMER	WYE-UNGROUNDED WYE-GROUNDED △ DELTA
500 W	500 W	SPACE HEATER	NUMERAL INDICATES WATTAGE
		MANUALLY OPERATED MOTOR STARTER WITH THERMAL DEVICE IN ALL 3 POLES	
	SEE MANUFACTURER'S PRINTS WHERE REQUIRED	MAGNETIC MOTOR STARTER WITH CONTROL TRANSFORMER	
	SEE MANUFACTURER'S PRINTS WHERE REQUIRED	MAGNETIC MOTOR STARTER WITH CONTROL TRANSFORMER AND PUSHBUTTON IN COVER	
	SEE MANUFACTURER'S PRINTS WHERE REQUIRED	COMBINATION MAGNETIC STARTER W/MAG CIRCUIT BREAKER AND CONTROL TRANSFORMER	(SEE NOTE 2)

ONE LINE	3-LINES, SCHEMATIC, & CONNECTION DIAGRAM
	SEE MANUFACTURER'S PRINTS WHERE REQUIRED
F R	SEE MANUFACTURER'S PRINTS WHERE REQUIRED
F S	SEE MANUFACTURER'S PRINTS WHERE REQUIRED
100 3P	100 3P
200 3P	200 3P
60 3P	60 3P
OL	OL
TD	TDC OR TDC
TD	TDC OR TDC
TD	TDO OR TDO
TD	TDO OR TDO
	START
	STOP

USED FOR	REMARKS
COMBINATION MAGNETIC STARTER W/MAG CIRCUIT BREAKER CONTROL TRANSFORMER AND PUSHBUTTON IN COVER	(SEE NOTE #2)
OMBINATION REVERSING MAGNETIC MOTOR TARTER W/MAG CIRCUIT BREAKER AND CONTROL TRANSFORMER	(SEE NOTE #2)
COMBINATION TWO-SPEED MAGNETIC MOTOR STARTER W/MAG CIRCUIT BREAKER AND CONTROL TRANSFORMER	(SEE NOTE #2)
POWER CIRCUIT BREAKER	SHOW AMPERE RATING AND INTERRUPTING CAPACITY
DISCONNECTING SWITCH NON-FUSIBLE	NUMERAL INDICATES SWITCH SIZE IN AMPERES & NUMBER OF POLES
HORN GAP OR LOAD BREAK DISCONNECTING SWITCH	NUMERAL INDICATES SWITCH SIZE IN AMPERES & NUMBER OF POLES
DOUBLE THROW/TRANSFER SWITCH NON-FUSIBLE	NUMERAL INDICATES SWITCH SIZE IN AMPERES & NUMBER OF POLES
LAY, ALARM, STARTER, INTERLOCK CONTROL, AUXILIARY SWITCH FOR ELEC OPERATED CIRCUIT BREAKER	NORMALLY OPEN CONTACT(OPEN WHEN ITS OPERTING COIL IS DE-ENERGIZED)
LAY, ALARM, STARTER, INTERLOCK CONTROL, AUXILIARY SWITCH FOR ELEC OPERATED CIRCUIT BREAKER	NORMALLY CLOSED CONTACT(CLOSED WHEN ITS OPERTING COIL IS DE-ENERGIZED)
TOR OVERLOAD CONTACT	ALWAYS SHOWN NORMALLY CLOSED (OPEN ONLY OVERLOAD TRIP)
NORMALLY CLOSED CONTACT WITH TIME DELAY CLOSING FEATURE	THE POINT OF THE ARROW INDICATES THE DIRECTION OF SWITCH OPERATION IN WHICH CONTACT ACTION IS DELAYED
NORMALLY OPEN CONTACT WITH TIME DELAY CLOSING FEATURE	THE POINT OF THE ARROW INDICATES THE DIRECTION OF SWITCH OPERATION IN WHICH CONTACT ACTION IS DELAYED
NORMALLY CLOSED CONTACT WITH TIME DELAY OPENING FEATURE	THE POINT OF THE ARROW INDICATES THE DIRECTION OF SWITCH OPERATION IN WHICH CONTACT ACTION IS DELAYED
NORMALLY OPEN CONTACT WITH TIME DELAY OPENING FEATURE	THE POINT OF THE ARROW INDICATES THE DIRECTION OF SWITCH OPERATION IN WHICH CONTACT ACTION IS DELAYED
START PUSHBUTTON	MOMENTARY OR SPRING RETURN CIRCUIT CLOSING (MAKE)
STOP PUSHBUTTON	MOMENTARY OR SPRING RETURN CIRCUIT OPENING (BREAK)

ONE LINE	3-LINES, SCHEMATIC, & CONNECTION DIAGRAM	USED FOR	REMARKS
	START STOP	START-STOP TYPE PUSHBUTTON	MOMENTARY OR SPRING RETURN (TWO CIRCUIT)
R	R	PILOT OR INDICATING LIGHT	ENCLOSED LETTER INDICATES COLOR

NOTE: COLOR INDICATES THE FOLLOWING FUNCTION.

G- GREEN
R- RED
W- WHITE (OPAL)

CONTROL PANELS

R - MOTOR RUNNING, NORMAL CONDITION
G - POWER AVAILABLE, MOTOR STOPPED
BL- AUTO MODE (H.O.A.)
W - CMC SWITCH LEGEND LIGHT OR POSITION SWITCH
A - READY, ALL PROCESS REQUIREMENTS SATISFACTORY

SWITCHGEAR

R - BREAKER CLOSED
G - BREAKER OPEN
A - AMBER, READY, ALL PROCESS REQUIREMENTS SATISFACTORY

LOCAL CONTROL STATION

R - MOTOR RUNNING
G - MOTOR STOPPED
BL- AUTO MODE (H.O.A.)

VALVE POSITION

G - OPEN
A - CLOSED

MCC

R - MOTOR RUNNING OR VALVE OPEN
G - MOTOR STOPPED OR VALVE CLOSED

NOTES:

1. ALL MOTOR STARTER CONTROL CIRCUITS ARE FURNISHED WITH FUSES BUT NOT SHOWN ON ONE-LINE DIAGRAMS.
2. BREAKER MAY BE REPLACED BY FUSIBLE DISCONNECT IN COMBINATION STARTER WHERE REQUIRED.
3. SYMBOLS [ ] INDICATES THAT ADDITIONAL CONTROLS EXIST FOR COMPLETE ELECTRICAL OPERATION. REFER TO APPROPRIATE MECHANICAL FLOW DIAGRAM(S), ELECTRICAL LOGIC AND SCHEMATIC DIAGRAMS.

DWG. NO. G-700-6004A REV.D | SHEET 1 OF 3

FLUOR DANIEL
ADVANCED TECHNOLOGY DIVISION

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER
ELECTRICAL
ONE-LINE ELEM. & WIRING DIAGRAMS
DRAFTING SYMBOLS
Figure 1.4-3

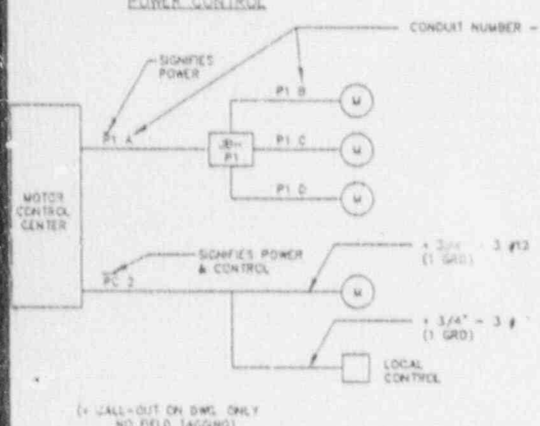
ONE LINE	3-LINES, SCHEMATIC, & CONNECTION DIAGRAM	USED FOR	REMARKS
A	START / STOP	START-STOP TYPE PUSHBUTTON	MOMENTARY OR SPRING RETURN (TWO CIRCUIT)
A	START / STOP	START-STOP PUSHBUTTON WITH INDICATING LIGHT	MOMENTARY OR SPRING RETURN (TWO CIRCUIT)
A	START / STOP	MAINTAINED START-STOP PUSHBUTTON	TWO CIRCUIT MAINTAINS CONTACT OPEN OR CLOSED NO SPRING RETURN.
A	H O A	THREE POSITION SELECTOR SWITCH	
A	STOP / START	MAINTAINED STOP MOMENTARY START PUSHBUTTON	SPRING RETURN TO RUN ON START ONLY. STOP MAINTAINS OPEN CONTACT.
	FLOW-ACTUATED SWITCH N.O. (CLOSES ON INCREASE IN FLOW) N.C. (OPENS ON INCREASE IN FLOW)		
	LIQUID-LEVEL-ACTUATED SWITCH N.O. (CLOSES ON RISING LEVEL) N.C. (OPENS ON RISING LEVEL)		
	PRESSURE OR VACUUM-ACTUATED SWITCH N.O. (CLOSES ON RISING PRESSURE) N.C. (OPENS ON RISING PRESSURE)		
	TEMPERATURE-ACTUATED SWITCH N.O. (CLOSES ON RISING TEMPERATURE) N.C. (OPENS ON RISING TEMPERATURE)		
	LIMIT ACTUATED SWITCH N.O. (CLOSES ON HIGH LIMIT) N.C. (OPENS ON HIGH LIMIT)		
		GROUND	
20	20	INDUCTION MOTOR	NUMERAL INDICATES HORSEPOWER
25/10	2 SPEED ONLY 25/10	INDUCTION MOTOR	NUMERAL INDICATES HORSEPOWER, FOR TWO-SPEED SHOW BOTH H.P.
60	60	SYNCHRONOUS MOTOR	NUMERAL INDICATES HORSEPOWER
G		SYNCHRONOUS GENERATOR	INDICATE GENERATOR RATING (VK, PF & VOLTAGE)
10 TG		MOTOR THERMOGUARDS	
		ELECTRICAL SOLENOID VALVE	
10 Ω	10 Ω	VARIABLE RESISTOR	NUMERAL INDICATES SIZE, OMIT ARROW FOR FIXED RESISTOR

ONE LI
+ −
OR
PE
1
INTERNAL WIRE WHEN SHOWN

...NE	3-LINES, SCHEMATIC, & CONNECTION DIAGRAM	USED FOR	REMARKS
		CABLE TERMINATOR OR POTHEAD	SHOW VOLTAGE RATING BESIDE DETAILED SYMBOL ONLY
	7.5 KV	CABLE TERMINATOR OR POTHEAD	SHOW VOLTAGE RATING BESIDE DETAILED SYMBOL ONLY
		LIGHTNING ARRESTER	
		CAPACITOR (FIXED)	
V DC	+ 125 V DC −	MULTI-CELL BATTERY	SHOW VOLTAGE POLARITY
	+	HALF WAVE RECTIFIER DRY OR ELECTROLYTIC	
	AC DC DC AC	FULL WAVE RECTIFIER DRY OR ELECTROLYTIC	
	R1 OR R1	OPERATING COIL, RELAY, STARTER, ETC.	IDENTIFY BY R1, R2, ETC. TD FOR TIME DELAY, ETC.
		PHOTO ELECTRIC RELAY (LIGHTING CONTROL)	
		POWER OUTLET	
		INTERLOCK	SEE NOTE #3
	1 2 3 4 5 6 — TERMINAL BLOCK NUMBERS; BLK Y R BL BRN GR — INDICATES WIRE COLORS; P1B-1 P1D-2 P1B-3 P1B-1 P1D-2 P1B-3 — EXTERNAL WIRE NUMBERS USE WHEN DIFFERENT FROM TERMINAL NUMBERS	TERMINAL BLOCK	SHOW TERMINAL NO. OR MARKING. ASSIGN A LETTER TO IDENTIFY BLOCK. BLK=BLACK, R=RED, BL=BLUE, OR=ORANGE, Y=YELLOW, BRN=BROWN, W=WHITE, GR=GREEN

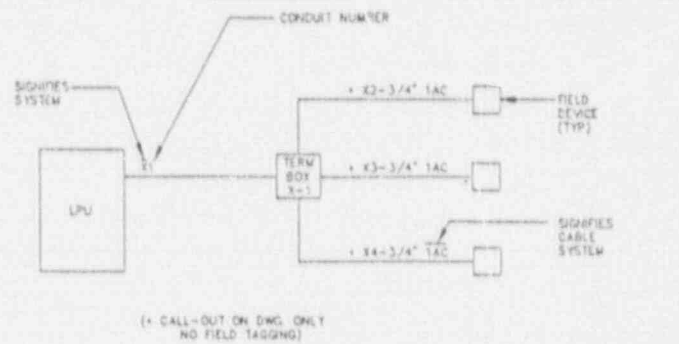
CONDUIT DESIGNATION

POWER CONTROL

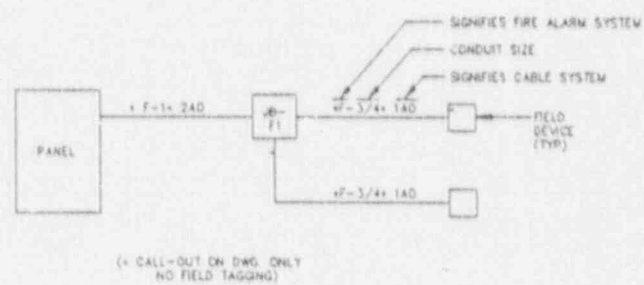


CONDUIT DESIGNATION (CONT'D.)

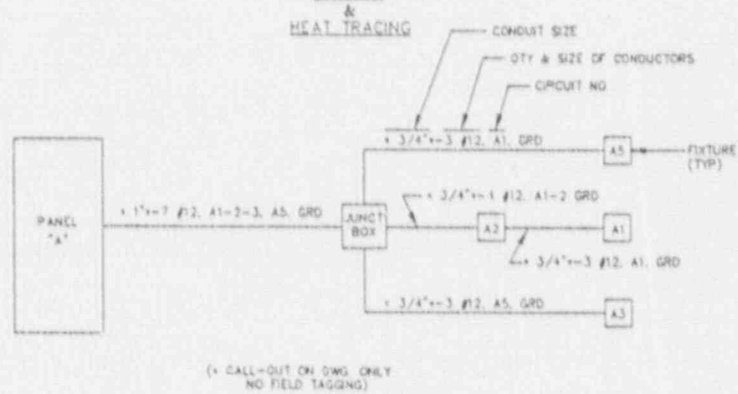
INSTRUMENTATION & COMMUNICATIONS



FIRE ALARM



LIGHTING & HEAT TRACING



CONDUIT DESIGNATION LEGEND

- A - ALARM
- C - CONTROL
- F - FIRE ALARM
- P - POWER
- T - TELECOMMUNICATION
- I - INSTRUMENTATION

NOTES:

1. SEE SHEET #1 FOR NOTES.

DWG. NO. G-70L-6004A REV.0 | SHEET 2 OF 3

LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

ELECTRICAL ONE-LINE ELEM. & WIRING DIAGRAMS DRAFTING SYMBOLS

Figure 1.4-3

FLUOR DANIEL ADVANCED TECHNOLOGY DIVISION

ACAD-BP-FIGGEA070

ONE LINE	DETAILED	DESCRIPTION
	USE APPROXIMATE OUTLINE OF ACTUAL INSTRUMENT INDICATE TERMINALS IN RELATIVE LOCATIONS SHOW POTENTIAL TERMINALS AS OPEN CIRCLES OR DOTS	INSTRUMENTS & METERS THE ASTERISK IS NOT PART OF THE SYMBOL. ALWAYS REPLACE THE ASTERISK WITH ONE OF THE FOLLOWING LETTER COMBINATIONS, DEPENDING ON THE FUNCTION OF THE METER OR INST . ENT. 25 = SYNCHRONIZING OR SYNCHRONISM-CHECK RELAY 26 = APPARATUS THERMAL DEVICE 27 = UNDERVOLTAGE RELAY 32 = DIRECTIONAL POWER RELAY 39 = MECHANICAL CONDITION MONITOR 40 = FIELD RELAY 46 = REVERSE PHASE OR PHASE BALANCE CURRENT RELAY 47 = PHASE SEQUENCE VOLTAGE RELAY 48 = INCOMPLETE SEQUENCE RELAY 49M = MOTOR THERMAL RELAY 49T = TRANSFORMER THERMAL RELAY 50 = INSTANTANEOUS OVERCURRENT OR RATE OF RISE RELAY 50G = INSTANTANEOUS OVERCURRENT RELAY (GROUND RETURN) 50GS = "0" SEQUENCE RELAY 51 = AC TIME OVERCURRENT RELAY 51G = TIME O.C. GRD. RELAY (GROUND RETURN) 51N = NEUTRAL TIME OVERCURRENT RESIDUAL OR DIFF. RELAY 52 = AC CIRCUIT BREAKER 60V = VOLTAGE BALANCE RELAY 64 = GROUND PROTECTIVE RELAY 67 = AC DIRECTIONAL OVERCURRENT RELAY 69 = PERMISSIVE CONTROL DEVICE 83 = AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY 86 = LOCKING-OUT RELAY 87 = DIFFERENTIAL PROTECTIVE RELAY 94 = TRIPPING OR TRIP-FREE RELAY AM = AMMETER AS = AMMETER SWITCH DM = DEMAND METER FM = FREQUENCY METER GD = GROUND DETECTOR PFM = POWER FACTOR METER REC = RECORDING RDM = RECORDING DEMAND METER SYN = SYNCHROSCOPE TLM = TELEMETER TI TEMPERATURE INDICATOR TT = THERMOSTAT VAR = VARMETER VM = VOLTMETER VS = VOLTMETER SWITCH WM = WATTMETER WHM = WATT-HOUR METER WHDM = WATT-HOUR DEMAND METER FOR ADDITIONAL DEVICE NUMBERS, GRAPHIC SYMBOLS OR ABBREVIATIONS, REFER TO ANSI Y32.2/IEEE STD 315 OR NEMA ICS 1-101

■ --TERMINAL
CENTERS
ETC.(SEE
□ --TERMINAL
◯ --TERMINAL

M ------ INDICAT
UPS ---- INDICAT
G ------ INDICAT
C ------ INDICAT
R ------ INDICAT
T ------ INDICAT
E ------ INDICAT
L ------ INDICAT
S ------ INDICAT
MP ----- INDICAT

BLK --------
R ----------
BL --------
OR --------
Y ----------
BRN --------
R/BLK ------
BL/BLK -----
OR/BLK -----
Y/BLK ------
BRN/BLK ----
BLK/R ------
BL/R ------
OR/R ------
Y/R --------
BRN/R ------
BLK/BL -----
R/BL ------
OR/BL ------
Y/BL -------
BRN/BL -----
W ----------
GR ---------

ELEMENTARY AND CONNECTION WIRING DIAGRAM LEGEND & SYMBOLS

WIRE LEGEND ON VENDOR DRAWING

INDICATES WIRING FURNISHED

INDICATES WIRING BY FIELD

TERMINAL LEGEND

I ELECTRICAL MOTOR CONTROL CENTERS, ESSENTIAL MOTOR CONTROL
ITCHGEAR, UNINTERRUPTABLE POWER SUPPLY DISTRIBUTION PANEL
C LEGEND BELOW)

N CONTROL PANEL

N FIELD

TERMINAL AND/OR EQUIPMENT LOCATION

S MOTOR CONTROL CENTER

S UNINTERRUPTIBLE POWER SUPPLY DISTRIBUTION PANEL

S STANDBY GENERATOR CONTROL PANEL/SWITCHGEAR

S CONTROL PANEL

S RELAY CABINET

S TERMINAL CABINET

S LOCAL CONTROL PANEL

S LOCAL AT EQUIPMENT

S UNIT SUBSTATION SWITCHGEAR

S RELAY CUBICLE IN MOTOR CONTROL CENTER

ABBREVIATIONS FOR WIRE COLOR

LACK

D

UE

ANGE

LLOW

OWN

D W/BLACK TRACER

UE W/BLACK TRACER

ANGE W/BLACK TRACER

LLOW W/BLACK TRACER

OWN W/BLACK TRACER

ACK W/RED TRACER

UE W/RED TRACER

ANGE W/RED TRACER

LLOW W/RED TRACER

OWN W/RED TRACER

ACK W/BLUE TRACER

D W/BLUE TRACER

ANGE W/BLUE TRACER

LLOW W/BLUE TRACER

OWN W/BLUE TRACER

ITE

EN (GRD)

ELECTRICAL EQUIPMENT IDENTIFICATION

X - XXX - XX - XXX - X - M

- M — MOTOR DESIGNATION
- X — QUANTITY IDENTIFIER, APPLICABLE WHEN THERE IS MORE THAN 1 UNIT. USE "A" FOR FIRST UNIT, "B" FOR SECOND UNIT, ETC.
- XXX — EQUIPMENT TAG NUMBERING
- XX — EQUIPMENT IDENTIFICATION CODE (SEE BELOW)
- XXX — SYSTEM NUMBER (SEE BELOW)
- X — PLANT UNIT (1, 2, 3 OR 0)

EXAMPLE:
1-700-MT-001A

SYSTEM NUMBERS

700 = GENERAL ELECTRICAL

710 = MAIN INCOMING GRID SYSTEM

720 = 13.8 KV DISTRIBUTION SYSTEM

0 = 480V, 60Hz DISTRIBUTION SYSTEM

731 = 415V, 50Hz HEX PUMP DRIVES

740 = CENTRIFUGE DRIVE SYSTEM

750 = STANDBY DIESEL-GENERATOR SYSTEM

EQUIPMENT IDENTIFICATION CODE

MP = MAIN BUS

GT = GRID STEP DOWN TRANSFORMER

MT = MAIN SUPPLY TRANSFORMER

AT = ALTERNATE SUPPLY TRANSFORMER

DG = DIESEL GENERATOR

DB = DRIVE SYSTEM DISTRIBUTION BOARD (MOTOR CONTROL CENTER)

PB = NON-ESSENTIAL AUXILIARY DISTRIBUTION BOARD (MOTOR CONTROL CENTER)

EB = ESSENTIAL AUXILIARY DISTRIBUTION BOARD (MOTOR CONTROL CENTER)

EC = ESSENTIAL SUPPLY DISTRIBUTION BOARD (MOTOR CONTROL CENTER)

BS = TIE BREAKER

9102060114-08

DWG. NO. G-700-6004A REV.0	SHEET 3 OF 3

FLUOR DANIEL

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

ELECTRICAL
ONE-LINE ELEM. & WIRING DIAGRAMS
DRAFTING SYMBOLS

Figure 1.4-3

ACAD DFW HGEN019

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2.0 THE SITE

In this chapter, information is presented pertaining to the physical, biological, and human characteristics of the area environs affected by Claiborne Enrichment Center. Present and projected information is presented concerning population, land use, water use, and historical significance from an environmental viewpoint.

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2.1 SITE LOCATION AND LAYOUT

2.1.1 SITE LOCATION

The Louisiana Energy Services Claiborne Enrichment Center (LES CEC) is located in northwest Louisiana in the central part of Claiborne Parish, approximately 50 miles east-northeast of Shreveport and 5 miles northeast of Homer, Louisiana. The CEC site location with respect to the state is shown in Figure 2.1-1 and the parish in Figure 2.1-2. Figure 2.1-8 shows the prominent features within 20 miles of the CEC.

Northern Louisiana was chosen as the region within the United States to locate the CEC for a number of reasons which are detailed in Section 7.1. Briefly, the factors favoring locating in northern Louisiana are as follows:

- within a zone of optimal proximity to suppliers of feed material and product users;
- an area of low seismic activity;
- a region of moderate peak wind speeds and moderate winter weather;
- within service area of one of the LES utility partners, Louisiana Power and Light, which will provide electric service;
- Louisiana is a "right-to-work" state with a favorable political atmosphere dedicated to attracting new industry into the state;
- available labor pool that is technically oriented;
- proximity to Interstate 20 which will be the primary transportation route for all feed and product material;
- abundance of rural areas within reasonable commuting distance to metropolitan areas.

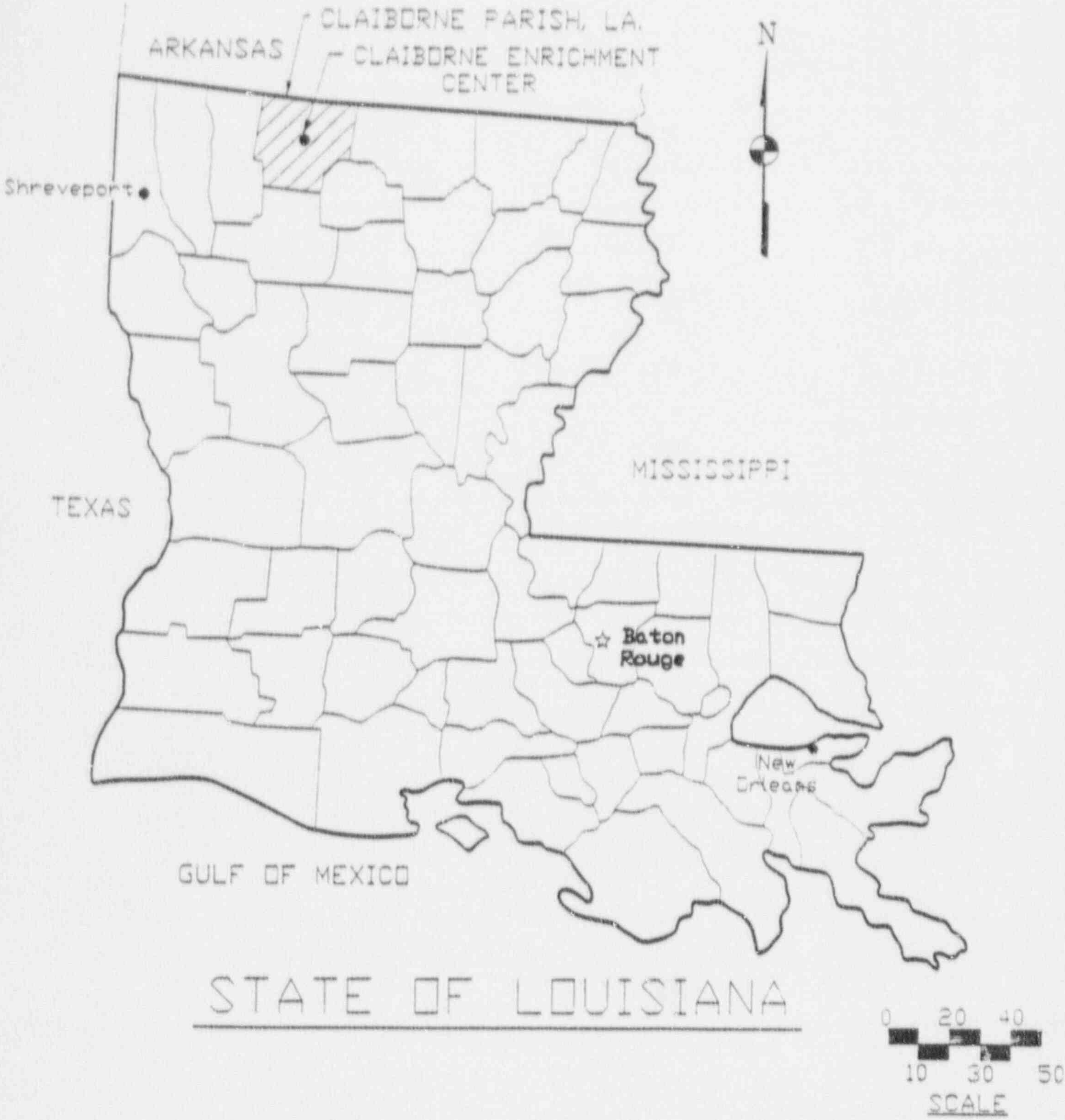
2.1.2 SITE LAYOUT

The 442 acre CEC site, shown in Figure 2.1-3, is bounded on all sides by privately owned property. Figure 2.1-4 is a topographical map of the area within two miles of the site and shows the relative amounts of woodland versus cleared land. Figures 2.1-5 and 2.1-6 are aerial photographs of the LES property as it appeared in August, 1990.

The 70 acre developed site area (controlled area) is shown in Figure 2.1-7. The various process, utility and administrative buildings and facilities are also shown. The remainder of the LES property outside the controlled area fence will remain in a natural state and serve as a buffer area with no other projected industrial uses.

There are no families or households displaced as a result of LES acquisition of the property for the construction and operation of the CEC.

Power shall be supplied to the Claiborne Enrichment Center under contract by Louisiana Power and Light through two separate and independent 115 KV transmission lines. These lines originate at the Bernice and Haynesville substations.

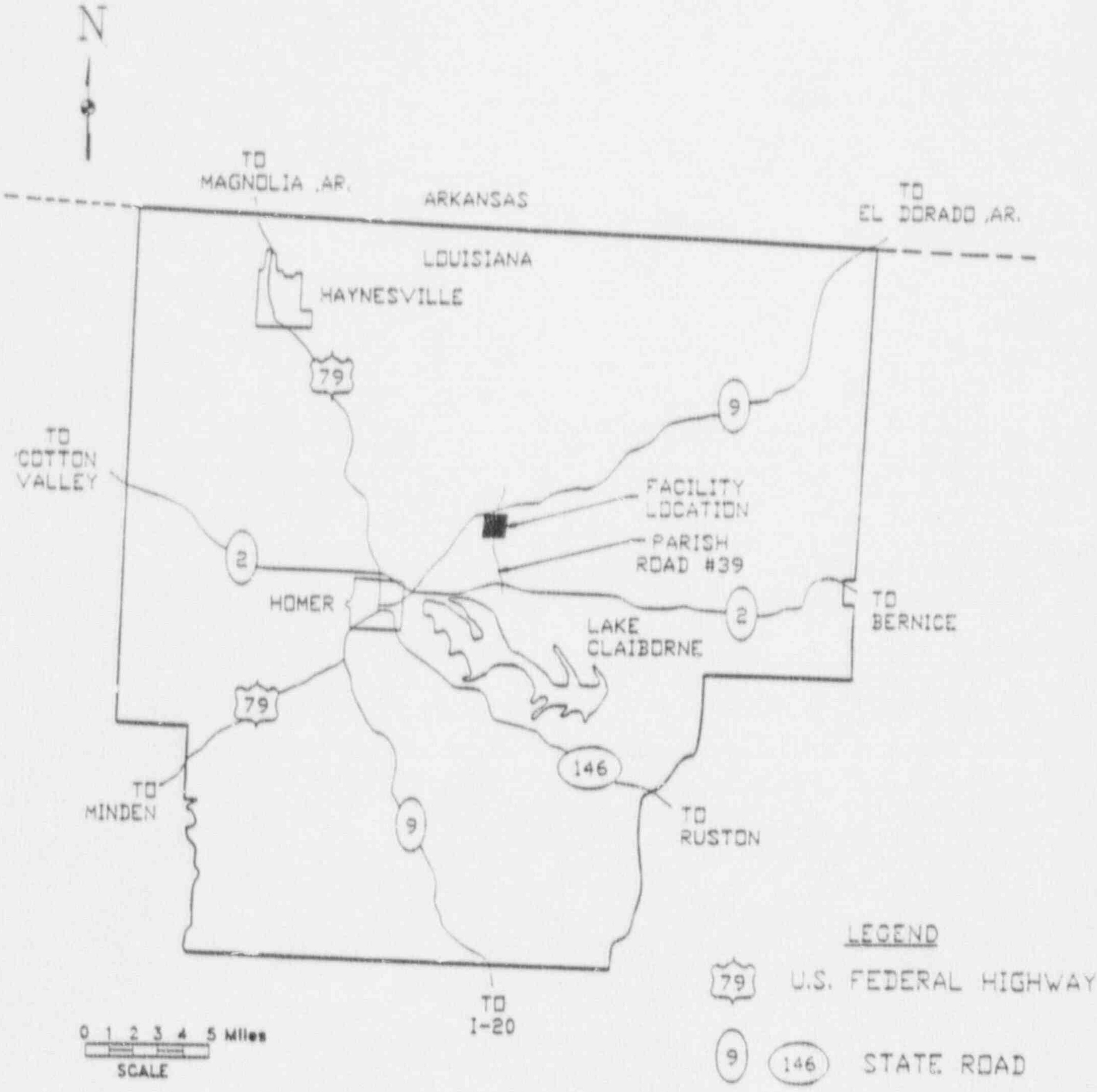


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Site Location in Louisiana

Figure 2.1-1



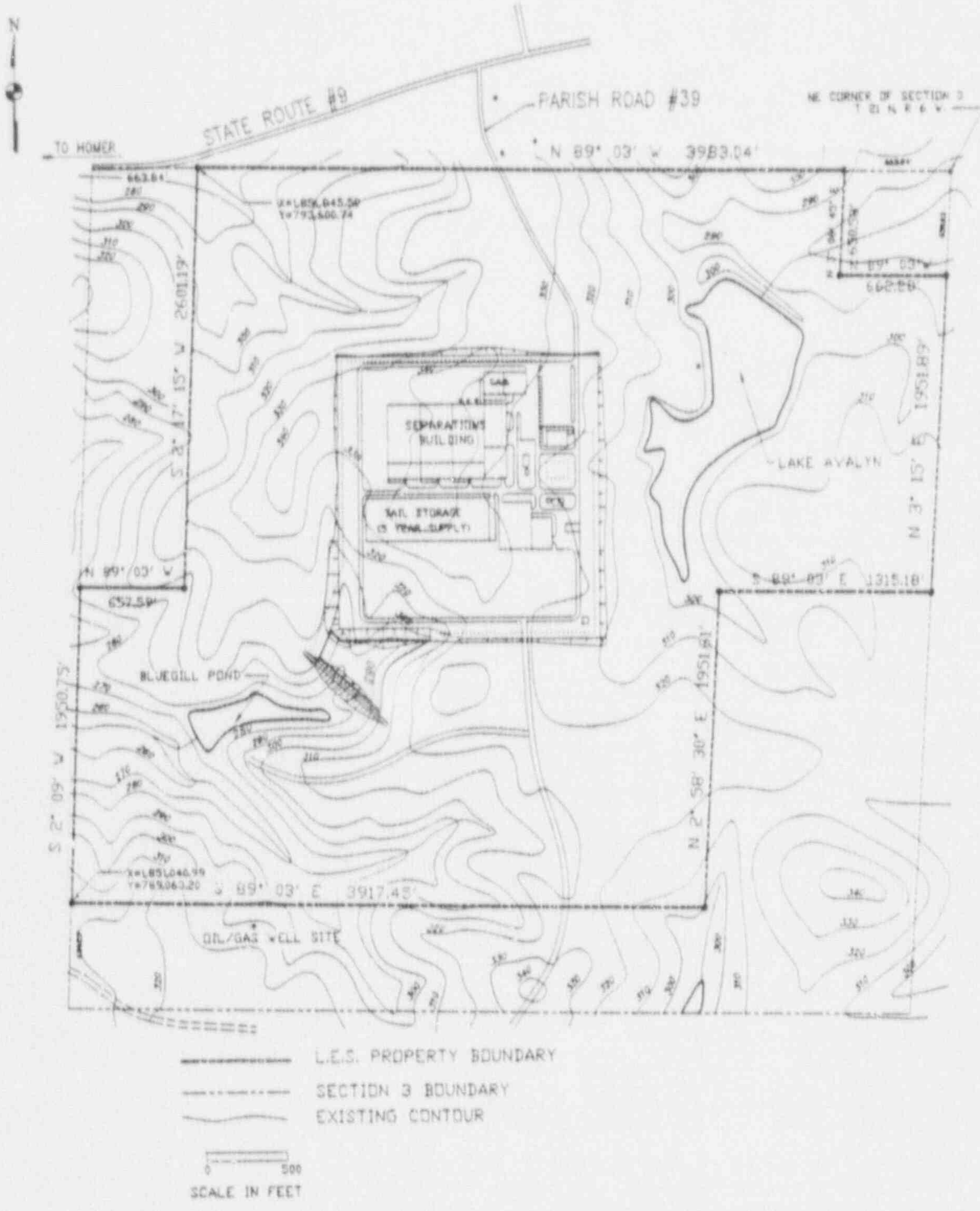
CLAIBORNE PARISH
LOUISIANA

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Site Location in Claiborne Parish

Figure 2.1-2



LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Plot Plan – Yard El. 324+6

Figure 2.1-3


KISATCHIE
NATIONAL FOREST
CLAIBORNE
ENRICHMENT
CENTER
Creek
Cypress
T22N
T21N
CEM
9
10

REFERENCE: UNITED STATES GEOLOGICAL SURVEY MAPS OF HOMER AND ARIZONA, LOUISIANA
MAP LAST EDITED 1986

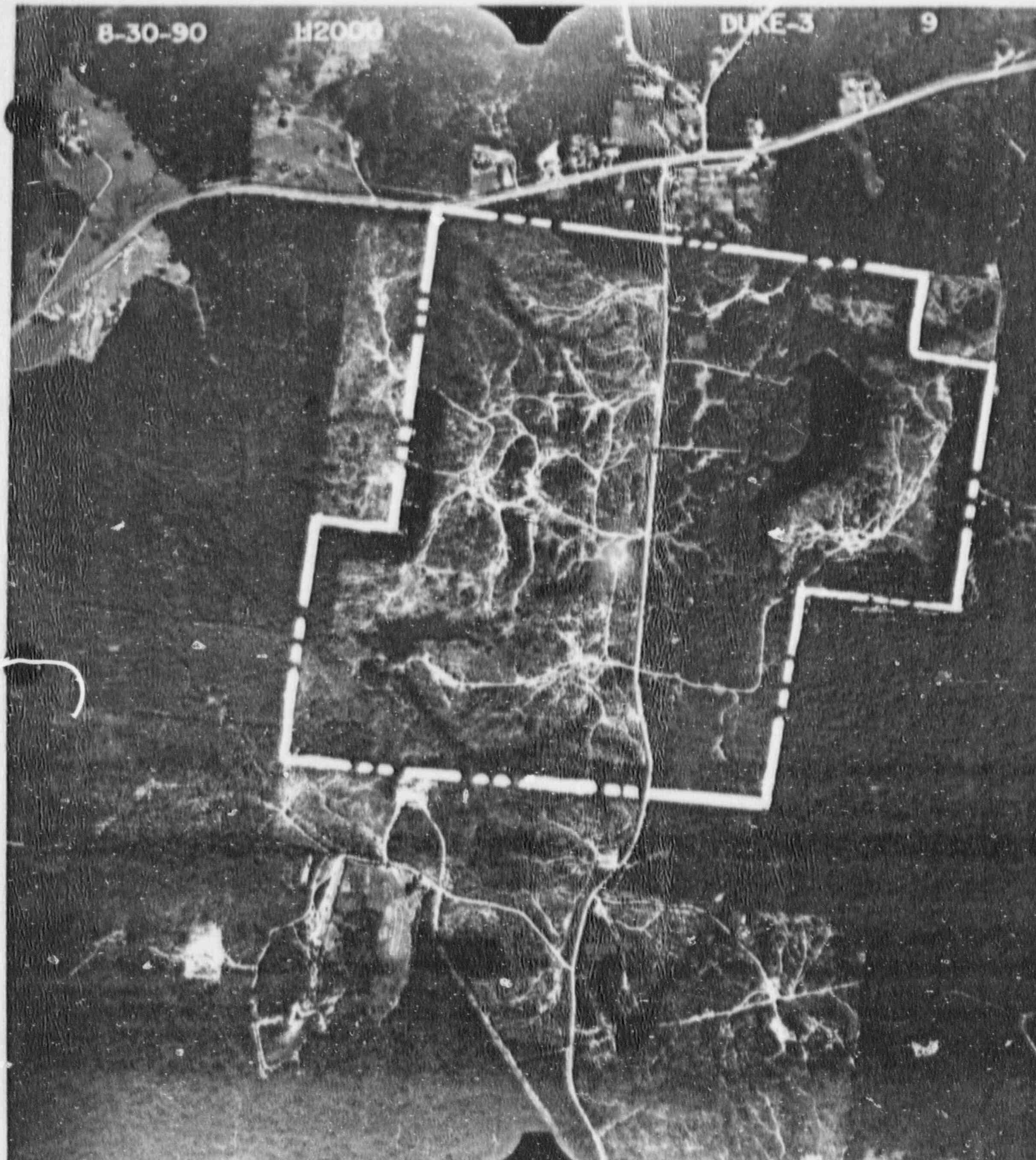
SCALE 1:24 000

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Two Mile Radius Topography Map

Figure 2.1-4

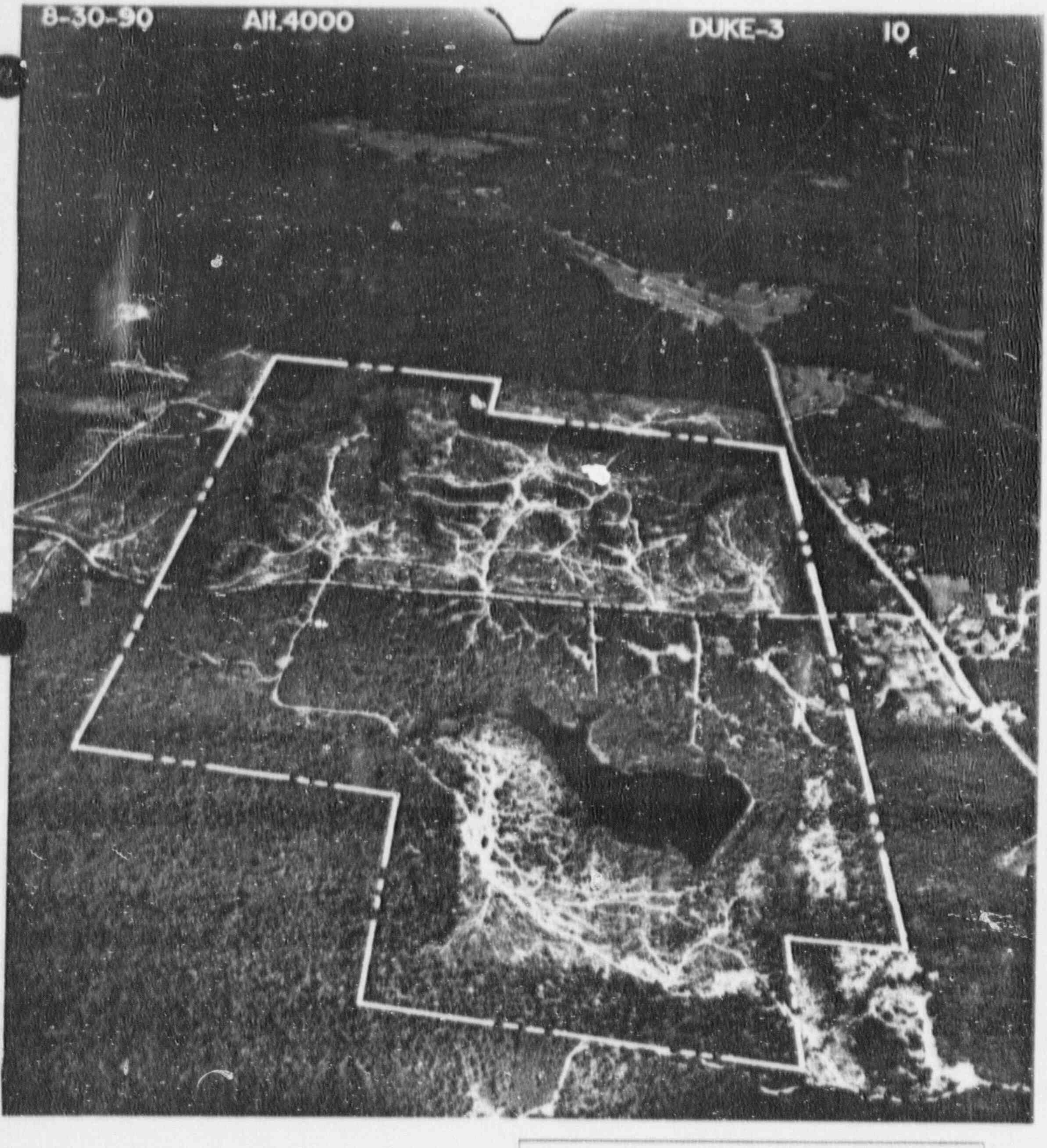


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

CEC Site
Aerial Photo
August, 1990

Figure 2.1-5

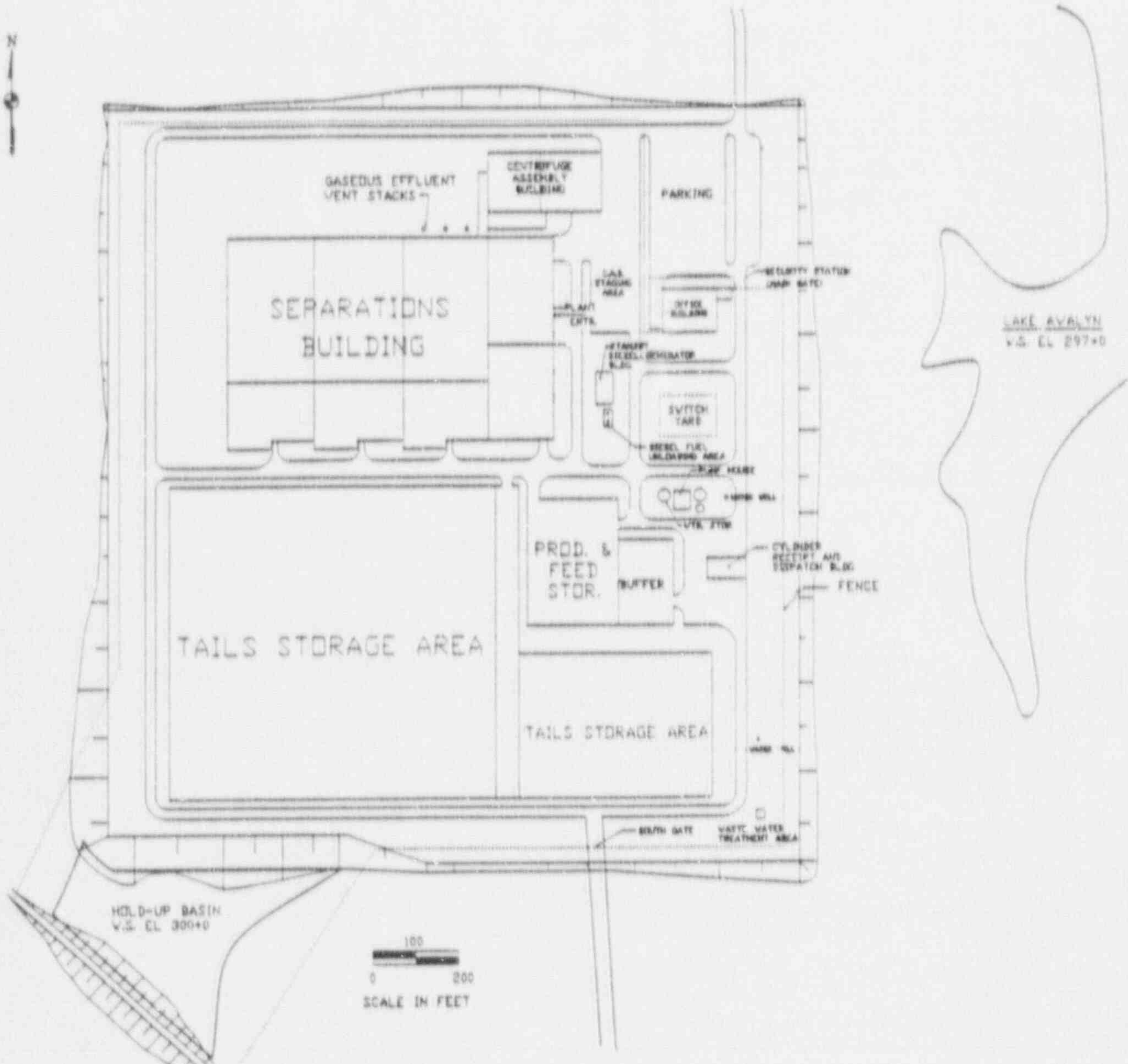


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

CEC Site
Aerial Photo
August, 1990 (looking west)

Figure 2.1-6

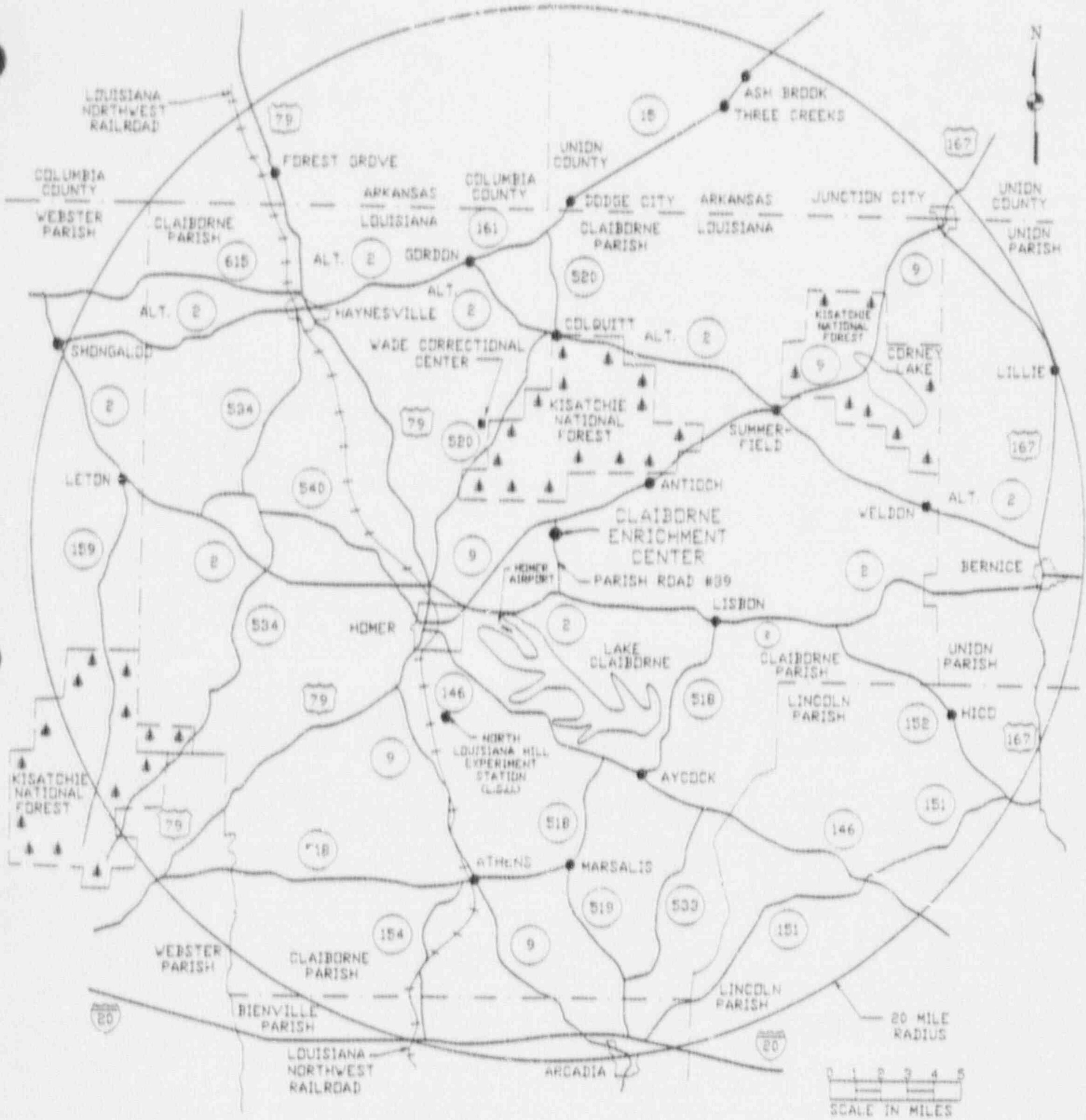


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Site Plan - Yard El. 324+6

Figure 2.1-7



LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

20 Mile Radius Map

Figure 2.1-8

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2.2 REGIONAL DEMOGRAPHY AND LAND AND WATER USE

The area around the Claiborne Enrichment Center (CEC) is sparsely populated. Within 5 mi of the facility, population densities are highest near the town of Homer and along the shore of Lake Claiborne.

2.2.1 DEMOGRAPHY

Population in Claiborne Parish has been relatively stable since the 1960's. In 1970 the population was 16,900, while in 1980 the population was 17,290 (Reference 1). The projected 1990 population is 18,526 (Reference 2).

2.2.1.1 Permanent Population

The permanent population within 5 mi of the site was determi. by an actual house count conducted on January 5, 1990. Results of the house count estimates that each household averages 2.85 persons (Reference 1). Radial sectors (22 1/2-degree sectors for radii of 1, 2, 3, 4 and 5 mi) are each assigned a number (Figure 2.2-1). The households in each radial sector are identified in Figure 2.2-2. The population for each radial sector identified in Figure 2.2-1 for the years 1990, 2000, 2010, 2020, 2030, and 2035 are given in Tables 2.2-1 through 2.2-6 . This range of years covers the date of expected plant start up (1995) through 40 years (2035). The distance from the CEC plant site to the nearest permanent household is reported in Table 2.2-7.

Future population estimates are based on projections made by the University of New Orleans and on extrapolation of these projections (Reference 2). Relative distribution of future populations is not expected to differ substantially from the distribution reflected in the 1990 house count.

Wade Correctional Institute is located 4 mi northwest of the site. This adult facility has a capacity of 1167 inmates and is maintained at full capacity. In addition, there are 370 employees employed at the facility (Reference 5).

As noted from the tables, the population within 5 miles of the site is not expexted to exceed 2000 by the year 2035.

2.2.1.2 Transient Population

At the present time, no schools are located within 5 mi of the site. However, the following schools draw part of their attendance from within the 5-mi area:

School	Location From Site	Enrollment	Faculty
Homer Elementary	6 mi southwest	606	27
Homer Junior High	6 mi southwest	419	19
Homer High	6 mi southwest	357	19
Pineview (Lisbon)	7 mi east-southeast	239	16
Summerfield	9 mi northeast	257	19

Presently, the parish has no expansion plan for the parish schools in the near future (Reference 3).

A small airport, Homer Aviation, is located approximately 4 mi south-southwest of the site. The airport has two permanently based small planes, and flights in and out of the airport are at most 2000 per year. Homer Aviation has a runway approximately 4,000 ft. in length. The runway is situated in a northwest - southeast direction. Normal flight paths to and from the airport do not cross the CEC site. The airport was built in the 1970's, and there are presently no plans for expansion (Reference 4).

The northern most sections of Lake Claiborne lie within 5 mi of the site. These areas have two types of transient populations:

a. Recreational Camps
b. Boaters (i.e., public launch in the northern section of the Lake.

Approximately 50% of the homes located on Lake Claiborne within the 5-mi radius of the site are not permanent residences. The number of transient and permanent households was estimated by reviewing the billing addresses for the water meters located at each home. If the billing address for the water meter was the same as that address for the location of the water meter, then that home was considered a permanent residence. If the billing address was different, the residence was considered to be a secondary residence and those that visit these households would be transient populations (Reference 6).

Lake Claiborne is used heavily for recreational activities including swimming, skiing, boating, and fishing. Lake Claiborne State Park is approximately 8 mi south-southeast of the CEC site. The Louisiana Office of State Parks recorded 48,200 visitors to the park during the 1988-1989 fiscal year (Reference 7). This facility is only one of many points of access to the lake. The total number of persons using the lake and which may enter areas of the lake within the 5-mi radius of the site is unknown. The Lake use is expected to change seasonally.

Kisatchie National Forest, Middle Fork section of the Caney Division, is approximately 3 mi north of the site. Most of the Middle Fork section is within the 5-mi radius of the site. The forest has campgrounds and open areas for hiking and hunting (Reference 8).

2.2.2 LAND USE

2.2.2.1 Agricultural

Land within the 5-mi radius is predominantly wooded or pasture. Much of the pasture land is unused, but there are six beef cattle ranches within 5 mi of the site; one approximately 4 mi east/northeast, one approximately 1.5 mi due west, one approximately 3 mi due east, one approximately 4 mi due south, one approximately 4.5 mi south/southeast, and one approximately 5 mi west/southwest. The locations of several beef cattle ranches are shown in Figure 2.2-3. The largest cattle operation as of December 1990, contained 68 cattle. No major agricultural operations are located within the 5 mile radius of the facility; however home gardens are commonly seen in inhabited areas.

2.2.2.2 Residential

Within 5 mi of the site, residential areas are most densely populated in the area near Homer and in the developed areas along Lake Claiborne. Outside of these areas, many residences are located along Louisiana Highway 9, which runs northeast from Homer and adjoins the northwest corner of the site. Rural residences are dispersed throughout the area.

2.2.2.3 Industrial

The only industry located within the 5 mile radius of the CEC site is oil/gas wells and oil/gas distributions pipelines. In the past, drilling for oil and gas has been extensive in Claiborne Parish. Present activity is much less than in the past; however, 31 active oil and gas wells (Reference 9) and 4 distribution pipelines (Reference 10) are located within a 5 mile radius of the site (Reference Figures 2.2-4 and 2.2-5). Table 2.2-8 contains specific information on each active well located within the 5 mile radius. Active wells are defined as currently producing or shut-in wells. Dry holes or formerly productive wells which are currently plugged and abandoned are not included in the list of wells. All of these wells would be expected to produce effluents intermittently.

2.2.2.4 Water Use

The largest use of surface water in the vicinity of the CEC site is for recreational purposes. The northern-most section of Lake Claiborne, which is within the 5 mile radius of the site, is used extensively for swimming, boating, water skiing, and fishing.

Several creeks, including Cypress and McCasland Creeks, are located within 5 miles of the site. These creeks are expected to be used for watering livestock.

Groundwater is the sole source of public water for Claiborne Parish. The majority of homes within a 5-mi radius of the CEC site are served by Central Claiborne Water System; with some served by Pine Hills Water System, Summerfield Water System, Middle Fork Water System, Lisbon Water System, and Wade Correctional Central Water System (Reference 11). All of these water systems obtain their water from the Sparta Aquifer. Use of private wells was determined through a door-to-door water use survey conducted within a 2-mi radius of the site. Of 51 individuals contacted, 40 responded with water use information. Of those that responded, 13 residences have private wells, 10 of which are currently used for domestic purposes in combination with and for gardening and livestock watering. Only 1 well is used for domestic purposes only. Projected water use in Claiborne Parish for 1990 was reported by Urban Systems (Reference 12). Based on these projections and the population density within a 5-mi radius of the site, the public, rural domestic and livestock water use for 1990 is projected to be 0.167 mgd, 0.018 mgd, and 0.013 mgd, respectively. Thus the total projected 1990 water use within 5 miles of the site is not expected to exceed 0.2 mgd for all combined uses. No industrial water use within the 5-mi radius of the site was identified.

REFERENCES (2.2)

1. Louisiana State Profile. Woods and Poole Economics, Inc., Washington, D. C., February 1989, pg. 122.

2. Telephone conversation with Mr. Vincent Maruggi, Division of Business and Economic Research, University of New Orleans, December 20, 1989.

3. Telephone conversation with Ms. Doris Lowe, Business Manager, Claiborne Parish School Board, December 21, 1989 and July 25, 1990.

4. Telephone conversation with Mr. Paul Chandler, airport employee, January 2, 1990.

5. Telephone conversation with Mr. Jerry Cantrell, Chief of Security, Wade Correctional Institute, January 9, 1990.

6. Hemphill, E.B., Letter to Mary Lee Hogg. Claiborne Pairsh Industrial Development Foundation, August 23, 1990

7. Telephone conversation with Mr. Robert Buquoi, Office of State Parks, January 2, 1990.

8. Telephone conversation with Mr. Miller, U. S. Forestry Service in Pineville, LA, July 25, 1990.

9. Louisiana Office of Conversation Files (Search performed by Energy Research Services, Inc., Baton Rouge, Louisiana), Duke Engineering & Services, Inc., File No. 6046-00-1600.10, Charlotte, NC.

10. Pipeline Map for Claiborne Parish Louisiana, DTC, Incorporated, Houston, Texas, 1990.

11. Personal Communication. Department of Health and Hospitals. Office of Public Health. Homer, Louisiana, January 3, 1990.

12. "Water Requirements and Availability for Louisiana, 1980-2020", Urban Systems. Prepared for Louisiana Department of Transportation and Development. Office of Public Works, Baton Rouge, Louisiana, 1982.

Table 2.2-1

Estimated Population for 1990
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
1	20
2	17
3	9
4	3
5	0
6	0
7	0
8	0
9	6
10	0
11	0
12	0
13	0
14	12
15	9
16	6
17	0
18	20
19	12
20	6
21	0
22	6
23	23
24	26
25	32
26	3
27	0
28	3
29	9
30	9
31	3
32	0
33	0
34	17
35	6
36	32
37	0
38	23
39	0
40	0
41	49
42	23
43	9

Table 2.2-1 (con't)

Estimated Population for 1990
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
44	40
45	3
46	3
47	9
48	0
49	0
50	17
51	12
52	26
53	9
54	6
55	15
56	3
57	15
58	29
59	3
60	0
61	0
62	3
63	0
64	29
65	0
66	0
67	0
68	6
69	17
70	0
71	29
72	34
73	244
74	289
75	213
76	51
77	6

Table 2.[illegible]-1 (con't)

Estimated Popul[illegible]tion for 1990
Within 5 Miles [illegible]f the CEC Site

	Sector Number	Estimated Number of People Residing in Sector[a]
	78	20
	79	0
	80	[illegible]
Totals	80	15[illegible]7

[a]Based on [illegible] es[illegible]im[illegible]ted population of 18526 persons in Cla[illegible]borne Parish in 1990 and an averag[illegible] [illegible] [illegible] persons per household. In cal[illegible]ulating the number of persons based o[illegible] 2.83 persons per household, if the calculated value was a fraction, then t[illegible]at fraction was rounded upward (i.e., 17.18 would be reported as 18).

Table 2.2-2

Estimated Population for 2000
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
1	22
2	19
3	10
4	4
5	0
6	0
7	0
8	0
9	7
10	0
11	0
12	0
13	0
14	14
15	10
16	7
17	0
18	22
19	14
20	7
21	0
22	7
23	26
24	29
25	35
26	4
27	0
28	4
29	10
30	10
31	4
32	0
33	0
34	19
35	7
36	35
37	0
38	26
39	0
40	0
41	54
42	26

Table 2.2-2 (con't)

Estimated Population for 2000
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
43	10
44	44
45	4
46	4
47	10
48	0
49	0
50	19
51	14
52	29
53	10
54	7
55	17
56	4
57	17
58	32
59	4
60	0
61	0
62	4
63	0
64	32
65	0
66	0
67	0
68	7
69	19
70	0
71	32
72	38
73	266
74	315
75	232
76	56
77	7

Table 2.2-2 (con't)

Estimated Population for 2000
Within 5 Miles of the CEC Site

	Sector Number	Estimated Number of People Residing in Sector[a]
	78	22
	79	0
	80	4
Totals	80	1691

[a]Based on an estimated population of 18526 persons in Claiborne Parish in 1990 and an average of 2.83 persons per household. In calculating the number of persons based on 2.83 persons per household, if the calculated value was a fraction, then that fraction was rounded upward (i.e., 17.18 would be reported as 18).

Table 2.2-3

Estimated Population for 2010
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[3]
1	23
2	20
3	11
4	4
5	0
6	0
7	0
8	0
9	7
10	0
11	0
12	0
13	0
14	14
15	11
16	7
17	0
18	23
19	14
20	7
21	0
22	7
23	27
24	30
25	37
26	4
27	0
28	4
29	11
30	11
31	4
32	0
33	0
34	20
35	7
36	37
37	0
38	27
39	0
40	0
41	56
42	27
43	11

Table 2.2-3 (con't)

Estimated Population for 2010
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
44	46
45	4
46	4
47	11
48	0
49	0
50	20
51	14
52	30
53	11
54	7
55	18
56	4
57	18
58	33
59	4
60	0
61	0
62	4
63	0
64	33
65	0
66	0
67	0
68	7
69	20
70	0
71	33
72	39
73	278
74	329
75	243
76	58
77	7

Table 2.2-3 (con't)

Estimated Population for 2010
Within 5 Miles of the CEC Site

	Sector Number	Estimated Number of People Residing in Sector[a]
	78	23
	79	0
	80	4
Totals	80	1763

[a]Based on an estimated population of 18526 persons in Claiborne Parish in 1990 and an average of 2.83 persons per household. In calculating the number of persons based on 2.83 persons per household, if the calculated value was a fraction, then that fraction was rounded upward (i.e., 17.18 would be reported as 18).

Table 2.2-4

Estimated Population for 2020
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
1	24
2	21
3	11
4	4
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	15
15	11
16	8
17	0
18	24
19	15
20	8
21	0
22	8
23	28
24	31
25	38
26	4
27	0
28	4
29	11
30	11
31	4
32	0
33	0
34	21
35	8
36	38
37	0
38	28
39	0
40	0
41	59
42	28
43	11

Table 2.2-4 (con't)

Estimated Population for 2020
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
44	48
45	4
46	4
47	11
48	0
49	0
50	21
51	15
52	31
53	11
54	8
55	18
56	4
57	18
58	35
59	4
60	0
61	0
62	4
63	0
64	35
65	0
66	0
67	0
68	8
69	21
70	0
71	35
72	41
73	290
74	343
75	253
76	61
77	8

Table 2.2-4 (con't)

Estimated Population for 2020
Within 5 Miles of the CEC Site

	Sector Number	Estimated Number of People Residing in Sector[a]
	78	24
	79	0
	80	4
Totals	80	1840

[a]Based on an estimated population of 18526 persons in Claiborne Parish in 1990 and an average of 2.83 persons per household. In calculating the number of persons based on 2.83 persons per household, if the calculated value was a fraction, then that fraction was rounded upward (i.e., 17.18 would be reported as 18).

Table 2.2-5

Estimated Population for 2030
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
1	25
2	22
3	12
4	4
5	0
6	0
7	0
8	0
9	8
10	0
11	0
12	0
13	0
14	15
15	12
16	8
17	0
18	25
19	15
20	8
21	0
22	8
23	29
24	33
25	40
26	4
27	0
28	4
29	12
30	12
31	4
32	0
33	0
34	22
35	8
36	40
37	0
38	29
39	0
40	0
41	61
42	29
43	12

Table 2.2-5 (con't)

Estimated Population for 2030
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
44	50
45	4
46	4
47	12
48	0
49	0
50	22
51	15
52	33
53	12
54	8
55	19
56	4
57	19
58	36
59	4
60	0
61	0
62	4
63	0
64	36
65	0
66	0
67	0
68	8
69	22
70	0
71	36
72	43
73	302
74	358
75	264
76	64
77	8

Table 2.2-5 (con't)

Estimated Population for 2030
Within 5 Miles of the CEC Site

	Sector Number	Estimated Number of People Residing in Sector[a]
	78	25
	79	0
	80	4
Totals	80	1917

[a]Based on an estimated population of 18526 persons in Claiborne Parish in 1990 and an average of 2.83 persons per household. In calculating the number of persons based on 2.83 persons per household, if the calculated value was a fraction, then that fraction was rounded upward (i.e., 17.18 would be reported as 18).

Table 2.2-6

Estimated Population for 2035
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
1	26
2	22
3	12
4	4
5	0
6	0
7	0
8	0
9	8
10	0
11	0
12	0
13	0
14	16
15	12
16	8
17	0
18	26
19	16
20	8
21	0
22	8
23	30
24	33
25	41
26	4
27	0
28	4
29	12
30	12
31	4
32	0
33	0
34	22
35	8
36	41
37	0
38	30
39	0
40	0
41	62
42	30
43	12

Table 2.2-6 (con't)

Estimated Population for 2035
Within 5 Miles of the CEC Site

Sector Number	Estimated Number of People Residing in Sector[a]
44	51
45	4
46	4
47	12
48	0
49	0
50	22
51	16
52	33
53	12
54	8
55	19
56	4
57	19
58	37
59	4
60	0
61	0
62	4
63	0
64	37
65	0
66	0
67	0
68	8
69	22
70	0
71	37
72	43
73	309
74	366
75	270
76	65
77	8

Table 2.2-6 (con't)

Estimated Population for 2035
Within 5 Miles of the CEC Site

	Sector Number	Estimated Number of People Residing in Sector[a]
	78	26
	79	0
	80	4
Totals	80	1955

[a]Based on an estimated population of 18526 persons in Claiborne Parish in 1990 and an average of 2.83 persons per household. In calculating the number of persons based on 2.83 persons per household, if the calculated value was a fraction, then that fraction was rounded upward (i.e., 17.18 would be reported as 18).

Table 2.2-7

Nearest Resident within each Compass Point Sector

Compass Point Sector	Distance from Site to Nearest Resident (Miles)
N	0.30
NNE	0.26
NE	0.43
ENE	1.56
E	3.00
ESE	1.91
SE	1.48
SSE	1.39
S	0.56
SSW	1.61
SW	3.74
WSW	1.75
W	1.13
WNW	0.87
NW	0.48
NNW	0.43

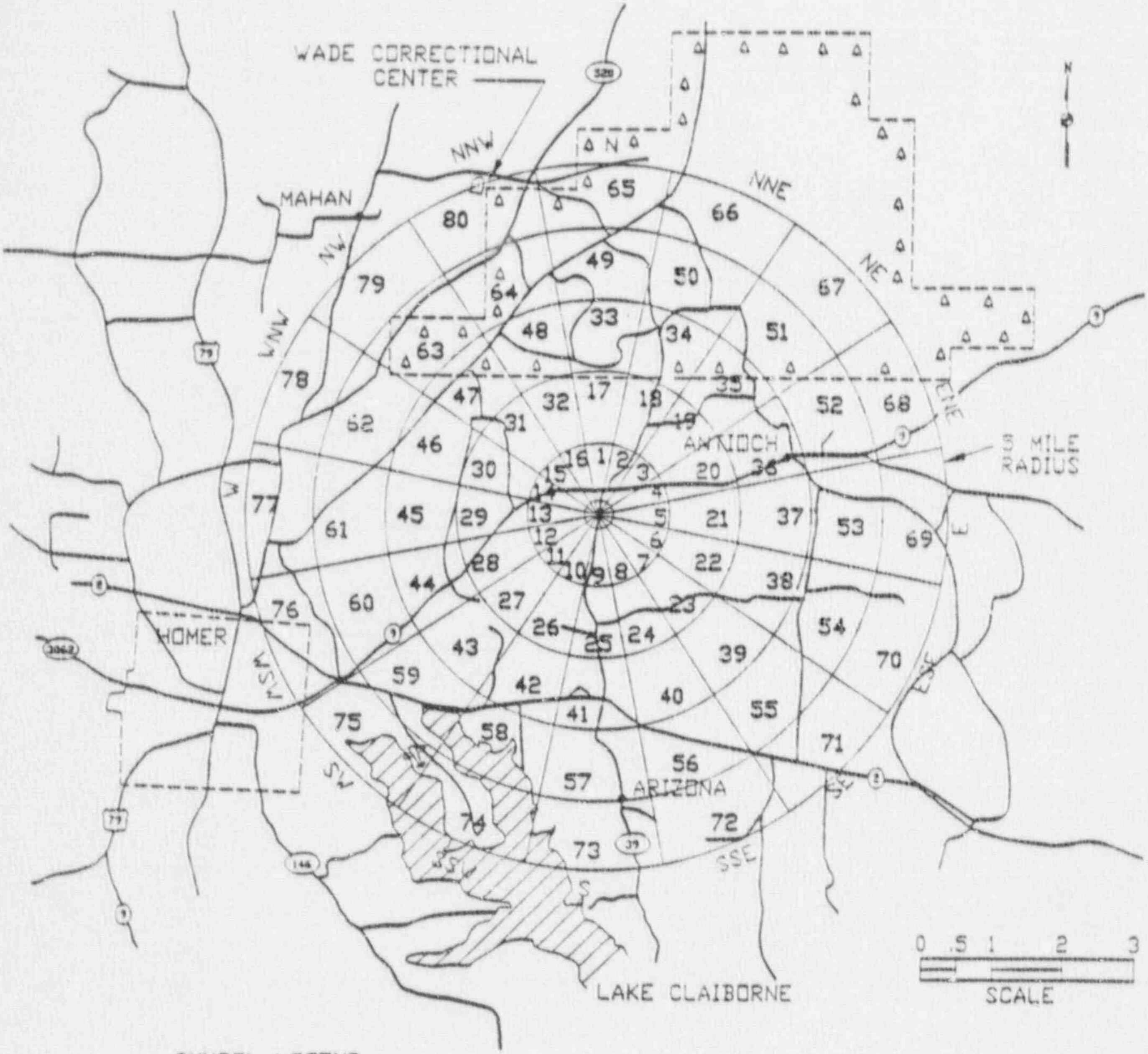
Table 2.2-8

Gas/Oil Wells Within a 5 Mile Radius

NUMBER	SERIAL NUMBER	STATUS CODE	DEPTH (FT)	BHP (PSIG)	TYPE	PRODUCTION POTENTIAL (1990)
1	211354	10	9400	3885	GAS	835 MCFD
2	208486	10	9293	4121	GAS	776 MCFD
.	208135	10	9450	N/A	OIL	51 BOPD
4	205566	10	9402	3151	GAS	1329 MCFD
5	201067	10	11000	2913	OIL	30 BOPD
6	184165	10	9650	N/A	GAS	65 MCFD
7	069264	10	5530	N/A	OIL	3 BOPD
8	066993	10	5290	N/A	OIL	3 BOPD
9	187926	10	5550	1745	OIL	0 BOPD
10	202144	10	11200	N/A	OIL	22 BOPD
11	166077	10	12023	3765	OIL	4 BOPD
12	204866	10	10451	5400	GAS	1209 MCFD
13	205435	10	11100	N/A	OIL	20 BOPD
14	206359	10	10500	1420	OIL	65 BOPD
15	205388	10	10400	N/A	OIL	60 BOPD
16	195050	10	10500	4600	OIL	454 BOPD
17	198829	10	10350	N/A	OIL	300 BOPD
18	202193	10	10700	N/A	OIL	104 BOPD
19	200579	10	10300	4381	OIL	2 BOPD
20	204687	10	10500	N/A	OIL	23 BOPD
21	067379	10	5475	N/A	OIL	2 BOPD
22	067246	42	5555	* INJECTION WELL *		
23	066813	63	5545	* INJECTION WELL *		
24	190903	10	11500	3091	OIL	52 BOPD
25	198743	10	13000	N/A	GAS	185 MCFD
26	178321	10	11350	4035	GAS	90 MCFD
27	176173	10	9409	3696	GAS	18 MCFD
28	180040	10	11436	3550	OIL	0 BOPD
29	160550	10	11234	4490	OIL	30 BOPD
30	210817	10	9300	N/A	GAS	1290 MCFD
31	212133	10	9500	3620	GAS	513 MCFD

Note: Well locations shown on Figure 2.2-4.

Terminology
1. Status Code
   10 - Currently Producing Well
   42 & 63 - Injection Well
2. BHP - Drill Pressure (Bore Hole Pressure)
3. MCFD - Million Cubic Feet Per Day
4. BOPD - Barrels Oil Per Day



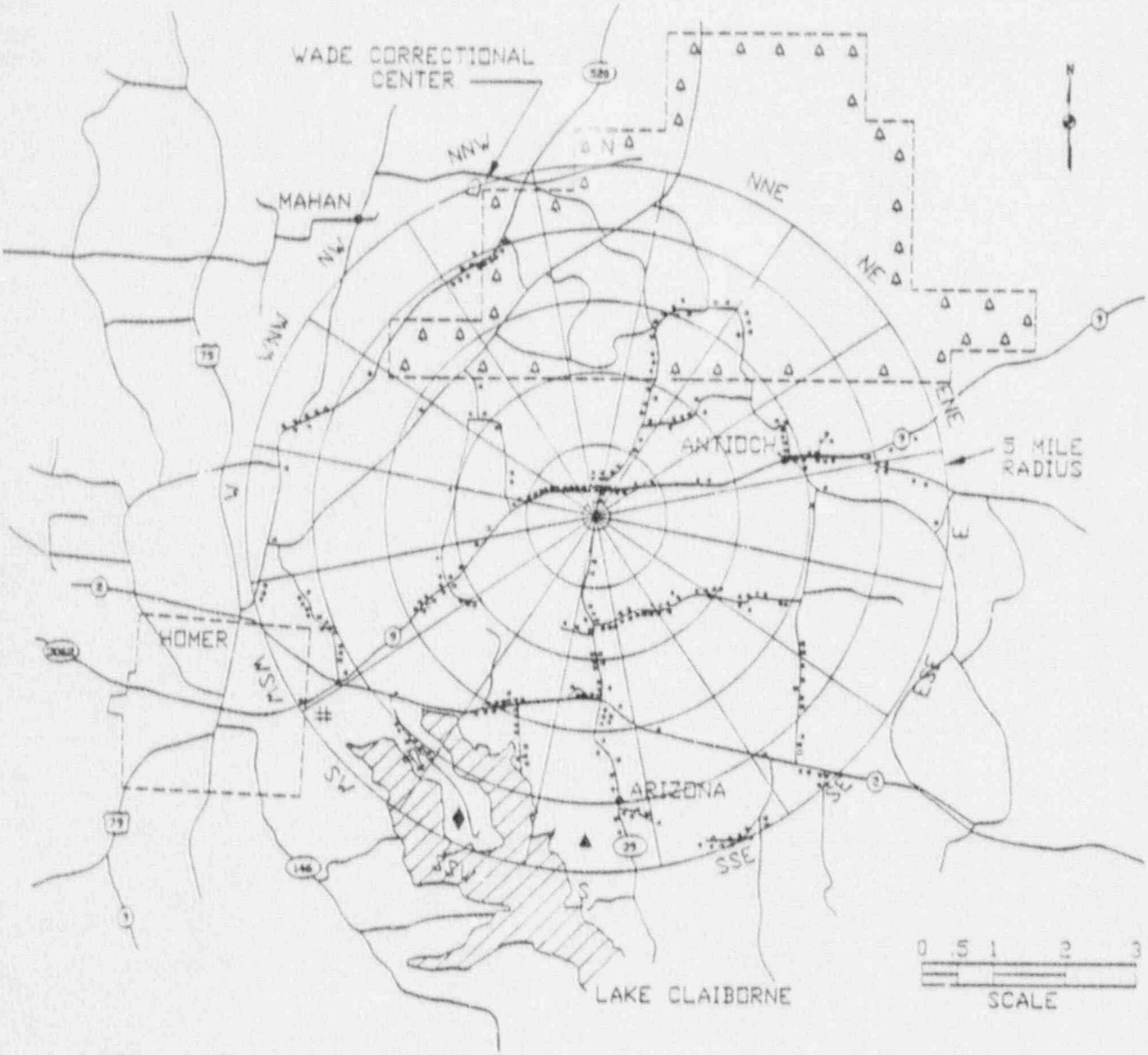
SYMBOL LEGEND

- US HIGHWAY
- STATE ROAD
- PARISH ROAD
- HOMER MUNICIPAL AIRPORT
- ENRICHMENT CENTER LOCATION
- KISATCHIE NATIONAL FOREST

LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

5 Mile Radius
Radial Sectors

Figure 2.2-1



SYMBOL LEGEND

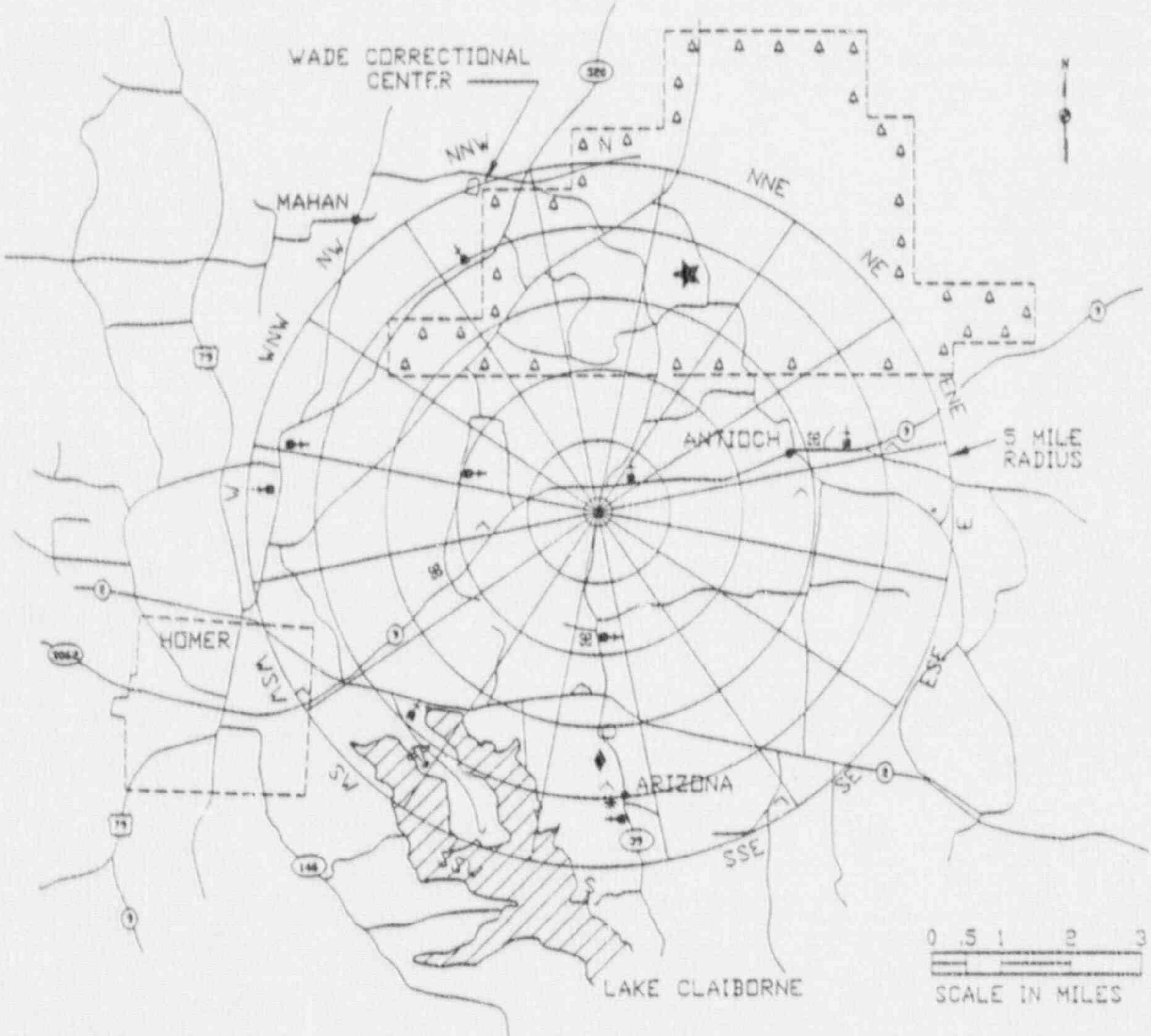
- 79 US HIGHWAY
- 9 STATE ROAD
- 146 PARISH ROAD
- HOMER MUNICIPAL AIRPORT
- ENRICHMENT CENTER LOCATION
- Δ KISATCHIE NATIONAL FOREST
- · ONE HOUSEHOLD
- ▲ REPRESENTS 80 HOUSEHOLDS IN SECTOR
- ♦ REPRESENTS 102 HOUSEHOLDS IN SECTOR
- # APARTMENT COMPLEX AND LOW INCOME HOUSING REPRESENTING 67 HOUSEHOLDS

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

5 Mile Radius Households in Radial Sectors

Figure 2.2-2



SYMBOL LEGEND

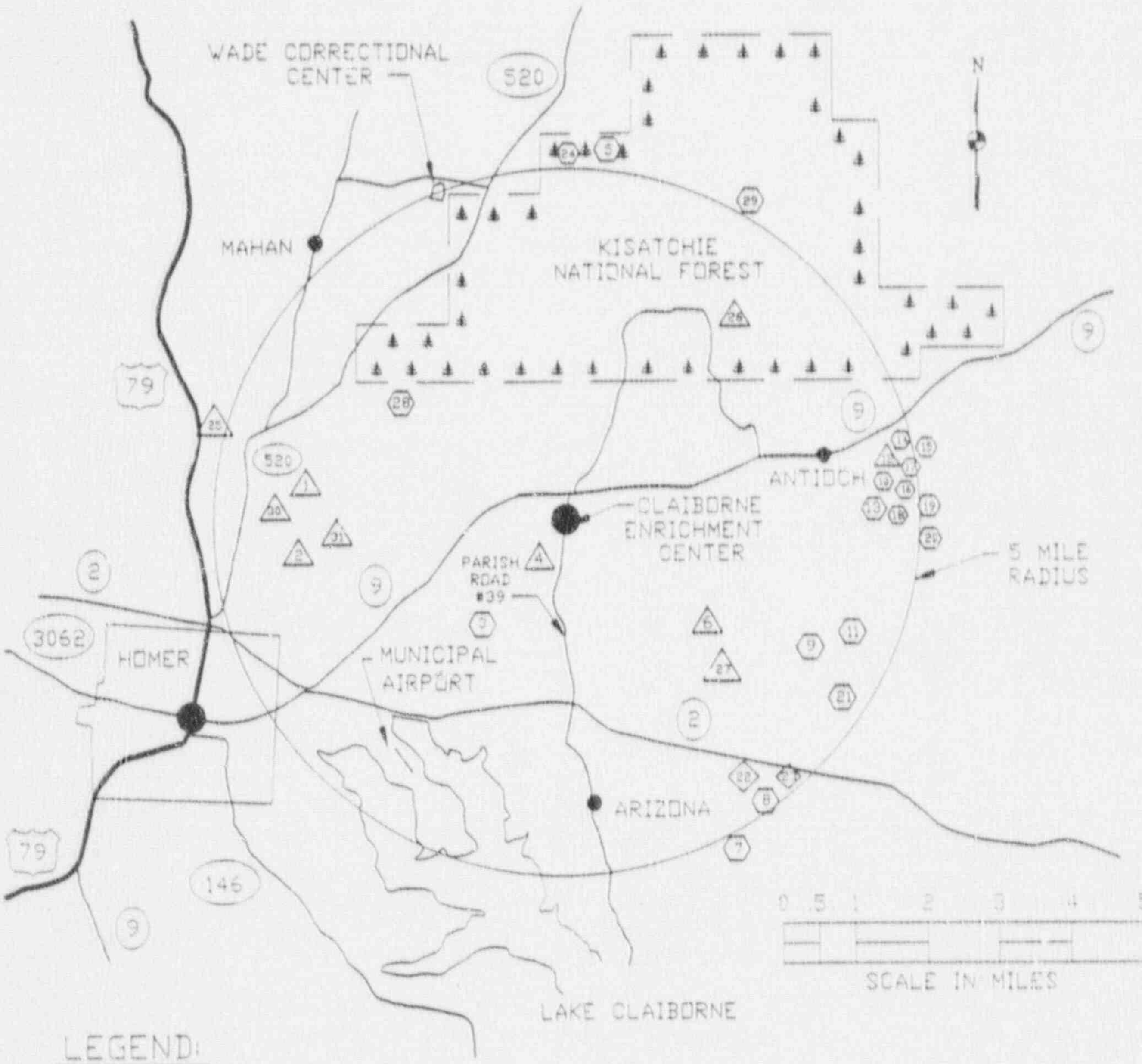
- US HIGHWAY
- STATE ROAD
- PARISH ROAD
- HOMER MUNICIPAL AIRPORT
- ENRICHMENT CENTER LOCATION
- KISATCHIE NATIONAL FOREST
- TURKEY TROT CAMPGROUND
- CHURCH
- CEMETARY
- BEEF CATTLE
- ARIZONA MUSEUM LANDMARK PLAQUE FOR
- ARIZONA ACADEMY SITE
- CENTRAL CLAIBORNE WATER DISTRICT

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Land Use

Figure 2.2-3



LEGEND:

△ -- GAS WELLS

⬡ -- OIL WELLS

◇ -- INJECTION WELLS

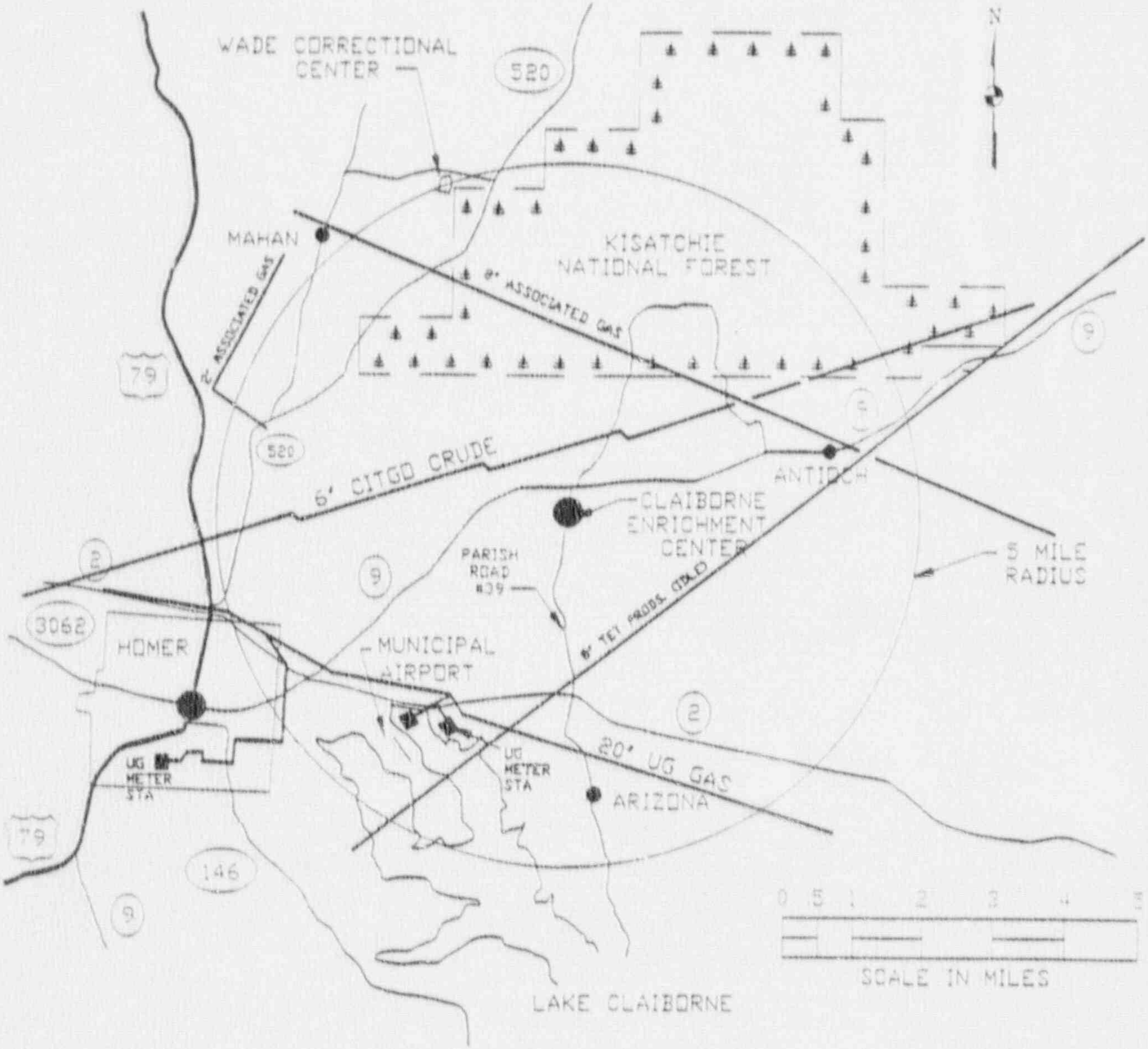
NOTE: SEE TABLE 2.2-8 FOR INFORMATION ON WELLS.

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Gas\Oil Wells
Within 5 Mile Radius

Figure 2.2-4



CLAIBORNE ENRICHMENT CENTER

Pipelines Within
5 Mile Radius

Figure 2.2-5

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2.3 REGIONAL HISTORIC, SCENIC, CULTURAL AND NATURAL LANDMARKS

The Arizona community, located approximately 4 mi south-southwest of the site, is of historical importance.

There are no significant cultural centers or activities within 5 mi of the site. The nearest cultural center is the Town of Homer.

Lake Claiborne, a man-made lake, is an outstanding natural landmark in the vicinity of the site.

Construction and operation of the facility is not expected to have any impact on these areas.

2.3.1 HISTORIC

There are several areas of historical interest within 5 mi of the site, all of them associated with the Arizona community. The Arizona Methodist Church, located approximately 3 1/2 mi from the site, is on the National Register of Historic Places (Reference 1). The Arizona Methodist Church was constructed about 1880. The church is described as "...one of the best known examples of Greek Revival church architecture in northern Louisiana and as the landmark of the Arizona vicinity" (Reference 2). This building is the only surviving intact historic landmark of the Arizona community, which during the postbellum period was a thriving town with a substantial cotton mill (the first built west of the Mississippi River) and academy. When the railroads were built in this area, Arizona was bypassed in favor of Homer, and the cotton mill closed shortly thereafter. The mill was torn down in 1900, but a chimney still stands. The Arizona Academy, started in 1869, closed in 1928 and is no longer standing (Reference 3). The Arizona Museum, built in authentic 19th century log-house style, was constructed from timbers taken from a home-site dated around 1880. The Museum, located less than 1/2 mi north of the Arizona Methodist Church, houses many antique farm implements and household items used in the past and has numerous photos and memorabilia from the Arizona community (see Figure 2.2-3 for the location of these historic landmarks).

The Forest Grove Cemetery, located approximately 2 mi south of the site is of historical interest (see Figure 2.2-3 for the location). This cemetery contains several pre-Civil war graves, the graves of four Civil War soldiers, and many mid to late 19th Century graves (Reference 3).

The State of Louisiana was contacted to determine if any areas of archaeological interest had been identified within 5 mi of the site. This state identified a reported, but unconfirmed, location of archaeological interest 5 mi south-southeast of the site. The reported location has not been surveyed, and no other information was available concerning the nature of the report. The state indicated that, based on their review of the environmental setting of the site, they would characterize the CEC site as having moderate potential for containing archaeological areas (Reference 4). However, an archaeological survey of the site was precluded due to previous uses of the land including the extensive logging activities initiated by the previous owner.

2.3.2 SCENIC

The area surrounding the Arizona community and Lake Claiborne is very scenic. However, no particular scenic landmarks have been designated by appropriate state agencies (Reference 4).

2.3.3 CULTURAL

The State of Louisiana, Department of Culture, Recreation and Tourism, reports that it has no cultural resources recorded within the 5-mi radius of the site (Reference 4). The town of Homer is the nearest cultural center.

2.3.4 NATURAL

Lake Claiborne, a man-made lake, is the outstanding natural landmark in the vicinity of the site. Lake Claiborne, constructed in 1965-1966, covers 6400 acres. However, only a portion of this lies within 5 mi of the site. It is extensively used for pleasure boating, fishing, and access to hunting areas.

REFERENCES (2.3)

1. Tassin, L., Letter of January 17, 1990 from Mr. Leslie Tassin, Louisiana State Historic preservation Officer with the State Department of Culture, Recreation and Tourism.

2. National Register of Historic Places Inventory - Nomination Form. From State Historic Preservation Officer, Robert DeBlieux, to the U. S. Department of the Interior. November 18, 1983.

3. Robinson, D., Personal conversation with Mrs. Dorris Robinson, local historian and Chairman of the Board, Arizona United Methodist Church. July 29, 1990.

4. Tassin, L., Letter of February 1, 1990 from Mr. Leslie Tassin, Louisiana State Historic Preservation Officer with the State Department of Culture, Recreation and Tourism.

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2.4 GEOLOGY

The site for the Claiborne Enrichment Center (CEC) is located in an area of rolling hills in northern Louisiana. The site comprises 442 acres, of which approximately 70 acres will be developed for the facility. Elevations range from roughly 340 feet above mean sea level (MSL) in the central portion of the site to 280 feet above MSL in the southern portion. The site drainage is to the west and south where small creeks have formed at the base of the hills. Vegetation is thick and composed of pine forest with some oak. Trees in the areas to be developed have been cleared, leaving stumps typically six inches high.

A review of the geological history of the site as well as in-depth field exploration was performed in order to clearly define the regional and site specific geology (Reference 1 and 2). A summary of the geological investigation of the site is discussed in this section. An in-depth discussion of the site geology and seismology is presented in Section 3.6 of the Safety Analysis Report (Reference 3).

2.4.1 AREA AND SITE GEOLOGY

The CEC site is located in the rolling hills and upland topography of the dissected plateau of the West Gulf Coastal Plain physiographic province. Major drainage features in north Louisiana are the Mississippi River to the east and the Red River to the west. The entire CEC site lies within the Red River drainage basin. Local drainage at the site flows into several small creeks which eventually feed into Lake Claiborne or Bayou D'Arbonne.

Structurally, the site lies on the Claiborne Platform that bridges between the north flank of the north Louisiana Basin and the southwest flank of the Monroe Uplift. This results in a slight southwesterly dip to the nearly horizontal strata. No structural faulting was noted at the site, although some faulting has occurred in the past in Claiborne Parish related to regional subsidence of the salt basin and salt intrusion.

Sediments encountered within the upper 100 feet at the site are identified as the Tertiary Cockfield and Cook Mountain Formations along with recent deposits of alluvium in and adjacent to drainages. The Tertiary deposits exhibit planar deposition and a southwesterly dip.

The Cockfield Formation is divided into a marine and non-marine unit. The non-marine unit is primarily composed of light brown fine-grained sands with some silts and clays and is exposed at the higher elevations in the northern areas of the site. The underlying marine unit contains some layers of siderite (iron) at the top overlying massive cross-bedded sands and glauconitic sands. These marine sands are dark green, but weather to red and brown as noted in the soil cover at the site. The total thickness of the lower marine unit is approximately 50 feet thick and lies unconformably over the Cook Mountain Formation.

The Cook Mountain Formation is divided into five lithologic units. The uppermost unit of the five units underlies the Cockfield Formation and is about 80 feet thick. This unit is composed of silt and clay about 40 feet thick and grades upward into 20 feet of glauconitic sand with siderite ledges and marine fossil casts. This in turn grades upward into about 20 feet of alternating thin beds of silt and clay, becoming sandy in the upper 2 to 3 feet before grading into the Cockfield Formation.

Recent alluvial sediments and colluvial sediments are present in downslope and low-lying areas of the drainages. These sediments are composed of light brown to gray sand with some silt, clay and chert gravel.

Surface soil conditions generally comprise 0 to 10 feet of loose to firm surficial silty fine sand overlying 6 to 15 feet of stiff to very stiff silty to sandy clay. These upper soils are underlain by 0 to 25 feet of stiff to very stiff clayey silt and 10 to 40 feet of firm to very dense silty fine sand. Generally, the lateral extent of the stiff to very stiff clayey silt is limited to the Process Area (i.e., Separations Building and Centrifuge Assembly Building). The lowest stratum encountered is a very stiff to hard silty clay typically beginning between Elevation 270 and 290 feet above MSL. Recent alluvial soils consisting of silty sands to clayey silts are encountered above the lower silty clay in the small creek areas near the location of the proposed Hold-Up Basin in the southwest corner of the site.

Groundwater levels varied across the site from a high of elevation 316 feet above MSL in the northwest to a low of elevation 270 feet above MSL in the southeast and southwest. Variations in groundwater levels were observed to be influenced by surface drainage features and ground elevation. Perched water conditions were encountered in 9 of 13 test pits at depths between 6 and 10 feet.

Site preparation activities will include the cutting of approximately 14 feet of soil from higher elevations and the filling of lower elevations to obtain a uniform site grade at Elevation 324+6 feet above MSL. Up to 30 feet of fill will be required in the lowest areas of the site. Surficial silty fine sand soils should be stripped and removed, or used in areas to be landscaped. The underlying silty to sandy clay soils will be suitable for compacted structural fill. The planned site layout is illustrated in Figure 2.4-1.

The planned development of the CEC site is particularly suited to the site conditions. The settlement sensitive Separations Building is appropriately located in an area that will be excavated of overburden soil, thereby significantly reducing the amount of settlement for foundations bearing in the exposed soils. Furthermore, the exposed bearing soil is stiff to very stiff and will provide ample bearing capacity with a low potential for shrinkage or swell.

The Support Facilities (i.e., Office Building, Cylinder Receipt and Dispatch Building, etc.) are also located appropriately within the site. Although fill placement will be required in this area to bring the site to grade, the depth of fill is limited. Structures planned for this area are also relatively lightly loaded and are not unusually settlement sensitive.

The largest quantities of fill will be required in the Tail Storage Area. This will not create a problem in this area since the underlying Stratum of stiff to very stiff clay is approximately 10 feet thick. Most settlement related to the fill surcharge will occur in the silty fine sand stratums below the clay during construction. Long-term consolidation settlements will be small due to the thin clay layer. In addition, the tail storage operation is not unusually settlement sensitive.

Location of the Hold-up Basin in the southwest corner of the site is strategically located to collect runoff which drains to the southwest through drainages south and west of the planned facilities. The topography of the natural drainage is also particularly suited to construction of the earthen embankment, as is evident by the many similarly constructed ponds in the area.

The lower subsurface stratum containing silty fine sand was analyzed for liquefaction potential. The analysis indicates that the sandy soils have negligible potential for liquefaction or induced pore pressures from earthquake loading. Computed earthquake induced settlements are less than 0.125 inch, and are considered to be low to negligible.

2.4.2 SEISMOLOGY

The site is located in the northern Louisiana, an area of low seismicity. The region is characterized by a very thick wedge of sediments overlying older Triassic and Paleozoic rocks. In the vicinity of the CEC site, approximately 18,000 feet of Cenozoic and Mesozoic sediments overlie the basement rocks.

Within the Gulf Coast, the site is located in the Interior Salt Basin seismotectonic region. Only six earthquakes with magnitudes exceeding m_b 3.5 have been reported in the area. The largest event to occur was a magnitude m_b 4.1 earthquake located more than 320 km (200 mi) from the site. The known earthquake closest to the site was a magnitude m_b 3.1 event occurring northwest of Shreveport, Louisiana (approximately 97 km (60 mi) from the site).

Historical data indicates that several large distant earthquakes may have been felt at the site. These distant earthquakes are responsible for the highest intensity shaking reported for northern Louisiana. The New Madrid earthquakes of 1811-1812, had magnitudes between m_b 7.0 and 7.3. These earthquakes may have produced intensity VI shaking at the site. Large earthquakes occurring near Memphis, Tennessee; Charleston, South Carolina; and Charleston, Missouri may have also been felt at the site. Although small earthquakes can occur in the region, the majority of the site seismic hazard is derived from regions 100 to 200 km (62 to 125 mi) from the site. Earthquakes reported within 320 km (200 mi) of the site are identified in Figure 2.4-2 and Table 2.4-2.

A probabilistic seismic hazard analysis was performed to develop a realistic curve of peak and effective ground acceleration versus probability of exceedence (return period).

The results of the probabilistic seismic hazard analysis are shown in Figure 2.4-3. The bedrock peak and effective acceleration for return periods of 100, 500 and 1000 years is given in Table 2.4-1. The bedrock accelerations are those values given directly by the ground motion attenuation relationships without adjustments for soil conditions at the site. The site soil conditions are considered in the generation of the site specific response spectra. The peak bedrock horizontal acceleration values are .017, .046 and .064 g for 100, 500 and 1000 year return periods, respectively. The effective acceleration is calculated as 70% of the peak acceleration. For return periods of 100, 500 and 1000 years, the effective bedrock horizontal acceleration is .012, .033 and .045 g, respectively. Peak and effective vertical accelerations were also determined and are given in Table 2.4-1.

Since much of the seismic hazard at the CEC site is generated at regional distances, three Design Bases Earthquakes are presented which produce levels of earthquake shaking hazard with a return period of 500 years. A near-field earthquake of m_b 4.3 about 15 km (9 mi) from the site, an m_b 5.7 mid-field earthquake about 105 km (65 mi) from the site and an m_b 6.7 far-field earthquake about 365 km (227 mi) from the site are the specified Design Basis Earthquakes.

The final site specific horizontal and vertical response spectra for the three design earthquakes are presented in Figures 2.4-4 through 2.4-9. The three spectra are compared in Figures 2.4-10 and 2.4-11. From this comparison, the large far-field event has the highest spectral amplitudes at frequencies below approximately 1.5 Hz, while the mid-field event dominates the ground motion considerations at frequencies above 1.5 Hz.

REFERENCES (2.4)

1. Law Engineering, Inc., Geotechnical Exploration Report, Louisiana Energy Services, Project No. Ht-3815-90G, Task 90, Dallas, Tx., September 15, 1990.

2 Law Engineering, Inc., Geologic and Seismic Report, Louisiana Energy Services, Project No. Ht-3815-90G, Task 90, Dallas, Tx., May 17, 1990.

3. Louisiana Energy Service, Claiborne Enrichment Facility, Safety Analysis Report.

Table 2.4-1

Probabilistic Acceleration Table

HORIZONTAL

RETURN PERIOD	PEAK ACCELERATION IN ROCK	EFFECTIVE ACCELERATION IN ROCK
100 Years	17 cm/s^2 (.017g)	12 cm/s^2 (.012g)
500 Years	45 cm/s^2 (.046g)	32 cm/s^2 (.033g)
1000 Years	63 cm/s^2 (.064g)	44 cm/s^2 (.045g)

VERTICAL

RETURN PERIOD	PEAK ACCELERATION IN ROCK	EFFECTIVE ACCELERATION IN ROCK
100 Years	12 cm/s^2 (.012g)	8 cm/s^2 (.008g)
500 Years	32 cm/s^2 (.033g)	22 cm/s^2 (.022g)
1000 Years	45 cm/s^2 (.046g)	32 cm/s^2 (.033g)

Table 2.4-2

Earthquakes Within 320 km (200 mi) of Site (p. 1 of 3)

Year	Date	Time (UTC)	Latitude N	Longitude W	Dist. (km)	Mag	Felt Area (sq km)	Io
1886	Jan 22	16:38	30.40	92.00	286.7	2.5		II
1891	Jan 8	6:00	31.70	95.20	244.2	3.8		VI
1898	Jan 27	1:35	34.60	90.60	294.5	3.1		IV
1905	Feb 3	0:00	30.50	91.10	315.?	3.5		V
1911	Mar 31	16:57	34.00	91.80	169.2	4.6	100.000	VII
1911	Mar 31	18:10	33.80	92.20	129.0	3.5	6.600	IV-V
1918	Oct 4	9:21	35.00	91.10	296.3	4.0	80.000	IV-V
1927	Nov 13	16:21	32.30	90.20	267.3	3.4	8.000	IV
1930	Oct 16	12:30	34.30	92.70	164.4	2.5		II
1930	Nov 16	12:30	34.30	92.80	163.2	3.3	900	V
1934	Apr 11	17:40	33.90	95.50	262.0	3.6	8.000	V
1936	Mar 14	17:20	34.00	95.20	243.1	3.4	2.200	V
1938	Apr 26	5:42	34.20	93.50	158.7	3.1		IV
1939	Jun 19	21:43	34.10	92.60	144.5	4.1	66.000	V
1940	Dec 2	16:16	33.00	94.00	96.9	3.1		IV
1941	Jun 28	18:30	32.30	90.80	212.9	3.0		III-IV
1947	Sep 20	21:30	31.90	92.60	110.4	3.3		IV-V
1952	Oct 17	15:48	30.10	93.70	312.2	3.1		IV
1956	Apr 2	16:03	34.20	95.60	286.1	3.5	5.000	V
1957	Mar 19	16:37	32.60	94.70	163.1	4.0	47.000	V
1957	Mar 19	17:41	32.60	94.70	163.1	2.5	3.000	III
1957	Mar 19	22:36	32.60	94.70	163.1	2.5	3.000	III
1957	Mar 19	22:45	32.60	94.70	163.1	2.5	3.000	III
1958	Nov 19	18:15	30.50	91.20	310.0	3.2	800	V
1960	May 4	16:31	34.20	92.00	176.4	3.8		IV
1961	Apr 26	7:05	34.60	95.00	270.6	3.8	6.600	III
1961	Apr 27	3:00	34.60	95.00	270.6	3.0		II
1961	Apr 27	5:00	34.60	95.00	270.6	3.0		II
1961	Apr 27	7:30	34.90	95.30	313.6	4.1	20.000	V
1963	Feb 7	21:18	34.40	92.10	191.6	3.4		
1964	Apr 24	1:20	31.38	93.81	180.2	3.3		V
1964	Apr 24	7:33	31.42	93.81	176.2	3.6		IV
1964	Apr 24	7:47	31.38	93.80	179.8	3.3		
1964	Apr 24	12:07	31.48	93.79	169.4	3.2		IV
1964	Apr 24	12:54	31.30	93.80	187.9	3.0		
1964	Apr 26	3:24	31.55	93.78	162.0	3.3		
1964	Apr 27	21:50	31.30	93.80	187.9	3.2		IV
1964	Apr 28	0:24	31.50	93.80	167.8	3.1		
1964	Apr 28	0:30	31.40	93.82	178.6	3.3	800	V
1964	Apr 28	21:18	31.63	93.80	155.1	3.4	2.600	VI
1964	Apr 30	21:30	31.20	94.00	206.2	3.0		III
1964	May 2	6:34	31.30	93.80	187.9	3.2		

Table 2.4-2

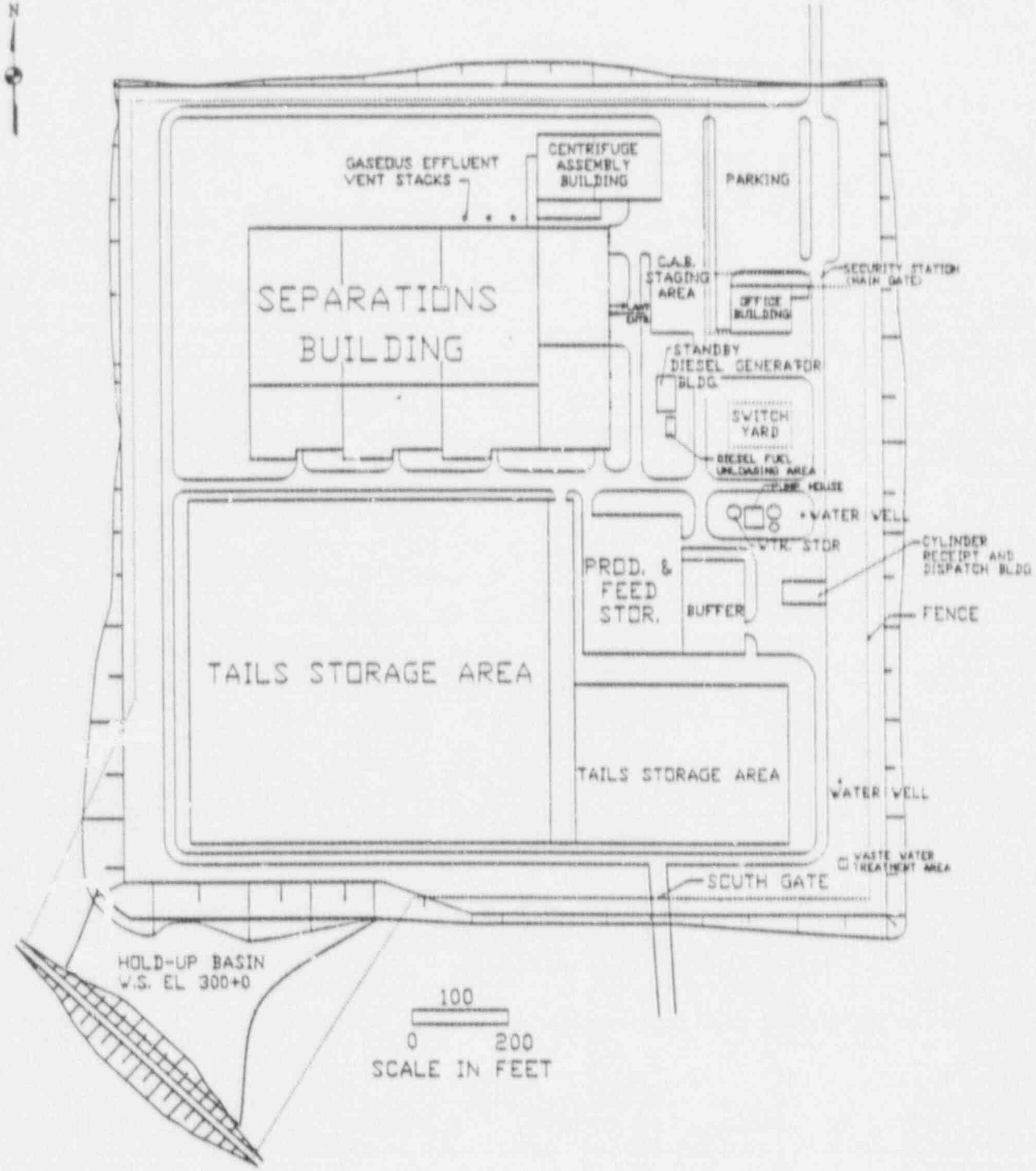
Earthquakes Within 320 km (200 mi) of Site (p. 2 of 3)

Year	Date	Time (UTC)	Latitude N	Longitude W	Dist. (km)	Mag	Felt Area (sq km)	Io
1964	May 3	3:24	31.30	93.80	187.9	3.0		V
1964	May 7	20:01	31.20	94.00	206.2	3.2		V
1964	Jun 2	23:00	31.30	94.00	177.8			V
1964	Jun 3	2:27	31.50	93.90	172.3	3.1		IV
1964	Jun 3	9:37	31.00	94.00	226.1	3.6		III-IV
1964	Aug 16	11:35	31.40	93.80	177.8	3.0		IV
1967	Jun 4	16:14	33.55	90.84	214.2	4.3	55.000	VI
1967	Jun 29	13:57	33.55	90.81	216.8	4.0		V
1969	Jan 1	23:35	34.99	92.69	240.6	4.4	60.000	VI
1973	Jan 8	9:11	33.80	90.60	245.6	3.5		III
1973	May 25	14:40	33.90	90.80	234.3	3.4		III
1973	May 25	14:42	33.90	90.80	234.3	3.2		
1973	Nov 18	10:03	35.00	94.70	287.9	3.1		
1974	Feb 15	22:32	34.04	92.98	133.4	3.5		III
1974	Feb 15	22:35	34.07	93.12	137.4	3.4		III
1974	Feb 15	22:49	34.03	93.04	132.4	3.8	16.000	V
1974	Dec 13	5:03	34.49	91.86	210.7	3.1		V
1975	Jan 2	9:19	34.90	90.90	298.9	3.0		II-III
1977	Jun 2	23:29	34.56	94.17	220.7	3.6		VI
1977	Nov 26	4:18	34.39	92.91	172.5	3.1		IV
1978	Sep 23	7:34	33.96	91.92	158.7	3.1		V
1981	Jun 9	1:46	31.99	94.32	157.3	3.2		III
1981	Nov 6	12:36	32.02	95.26	232.6	3.2	1.300	IV
1982	Jan 18	1:23	35.23	95.28	273.5	3.4		
1982	Jan 18	2:32	35.19	92.23	270.3	3.3		IV
1982	Jan 19	4:39	35.18	92.25	268.8	3.5		IV
1982	Jan 20	14:01	35.14	92.08	268.9	3.5		IV
1982	Jan 21	0:33	35.18	92.25	268.8	4.2		V
1982	Jan 21	1:13	35.18	92.21	269.7	3.5		
1982	Jan 21	15:45	35.17	92.14	270.4	3.8		III
1982	Jan 22	23:54	35.25	92.29	275.4	3.7		
1982	Jan 24	3:22	35.22	92.22	273.8	4.3		V
1982	Jan 27	23:29	35.21	92.24	272.2	3.2		
1982	Feb 1	5:55	35.20	92.28	270.2	3.6		IV
1982	Feb 1	7:25	35.19	92.25	269.8	3.6		
1982	Feb 12	5:32	35.27	92.29	277.6	3.0		
1982	Feb 24	19:27	35.29	92.25	280.6	3.9		V
1982	Mar 1	0:12	35.20	92.11	274.4	4.1		V
1982	Apr 21	21:17	35.18	92.24	269.0	3.5		
1982	May 31	17:49	35.21	92.25	272.0	2.9		IV
1982	May 31	18:21	35.20	92.23	271.4	3.5		
1982	Jun 30	16:22	35.34	92.13	288.8	3.3		

Table 2.4-2

Earthquakes Within 320 km (200 mi) of Site (p. 3 of 3)

Year	Date	Time (UTC)	Latitude N	Longitude W	Dist. (km)	Mag	Felt Area (sq km)	Io
1982	Jul 5	4:13	35.22	92.21	274.0	3.5		
1982	Sep 27	10:22	35.22	92.11	276.5	3.0		
1982	Nov 17	19:00	35.20	92.07	275.5	3.2		
1982	Nov 21	16:35	35.25	92.08	280.5	3.5		
1983	Jan 19	2:30	35.28	92.16	281.6	3.9		
1983	Mar 30	4:15	35.20	92.15	273.3	3.2		
1983	Oct 16	19:40	30.24	93.39	291.7	3.8		III
1984	Sep 27	13:30	35.25	92.21	277.2	3.4		IV

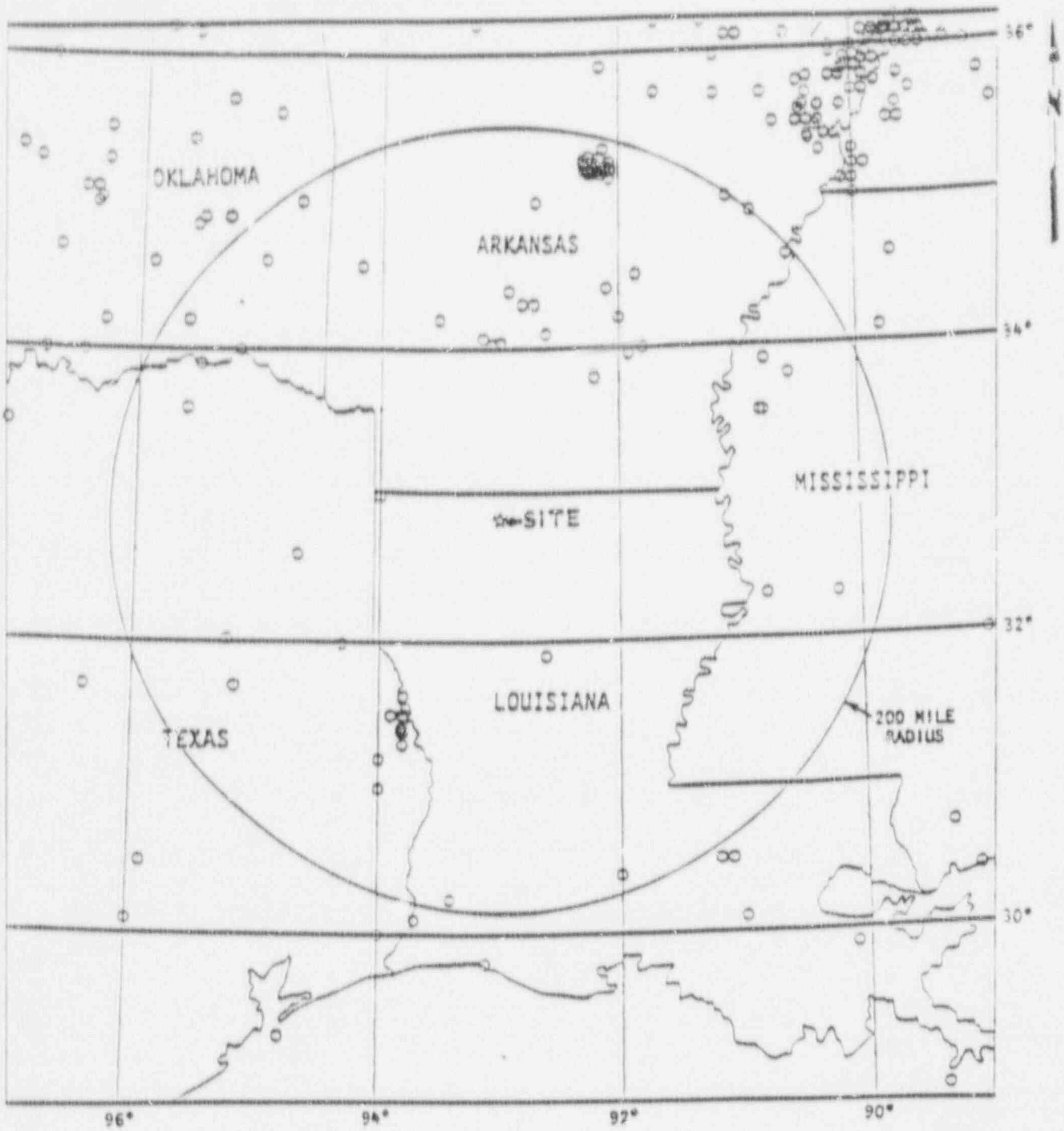


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Facility Buildings and Areas
Yard El. 324'+6"

Figure 2.4-1

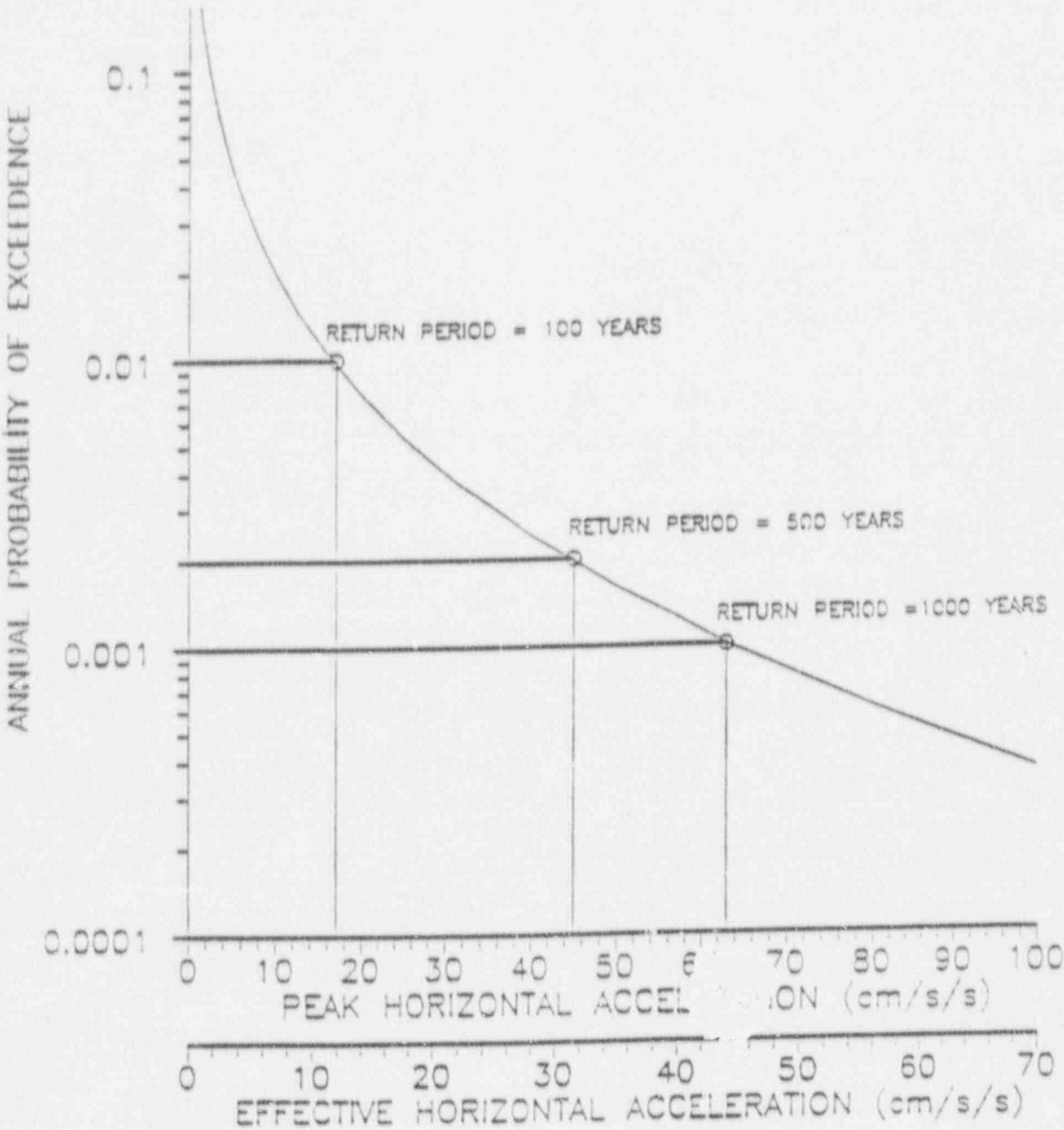


NOTE: SEE TABLE 2.4-2 FOR EARTHQUAKE PARAMETERS

CLAIBORNE ENRICHMENT CENTER

Location of Earthquakes

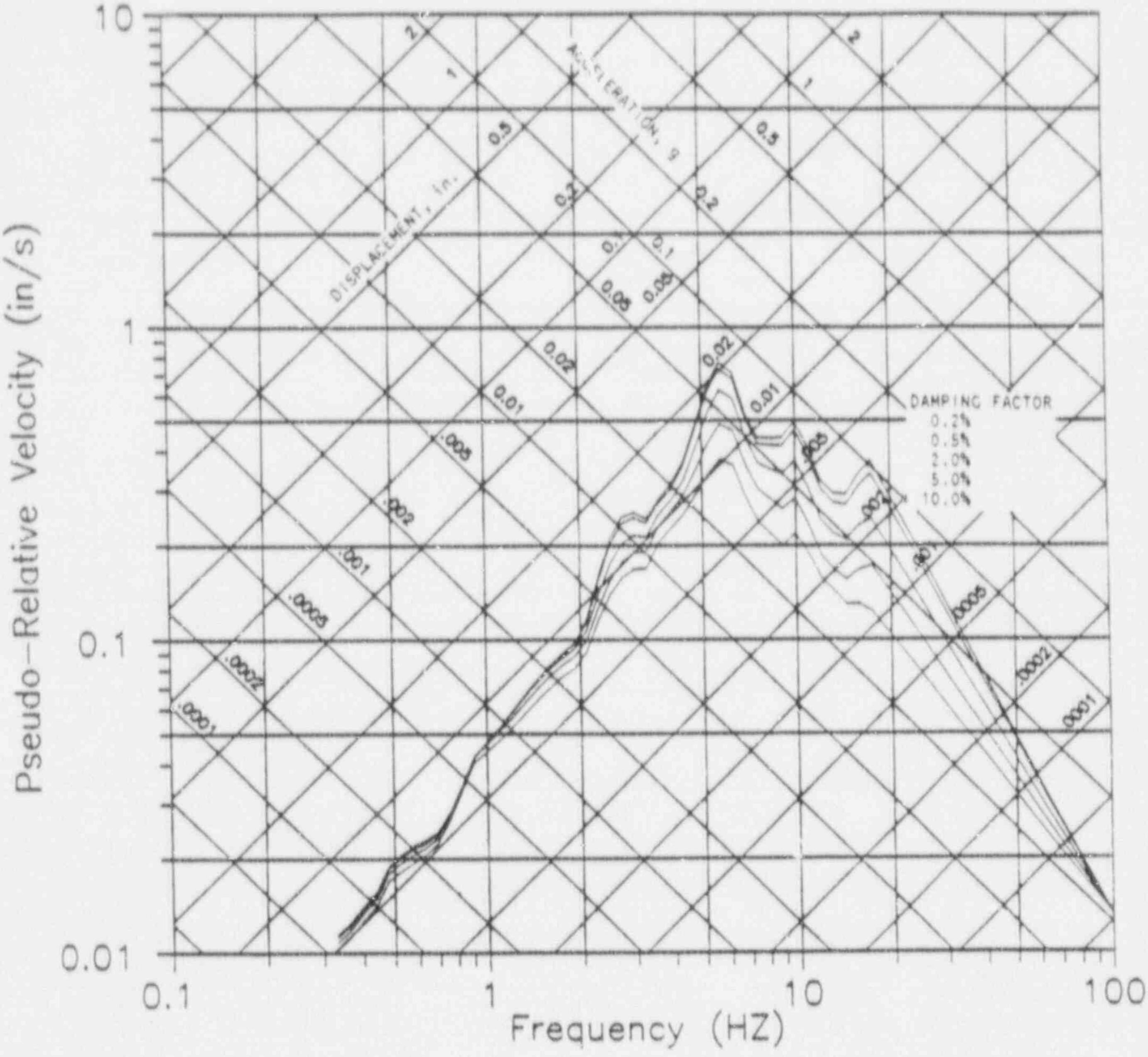
Figure 2.4-2



CLAIBORNE ENRICHMENT CENTER

Annual Probability of Exceedence vs Acceleration

Figure 2.4-3



m_b = 4.3
DISTANCE = 15km

LOUISIANA ENERGY

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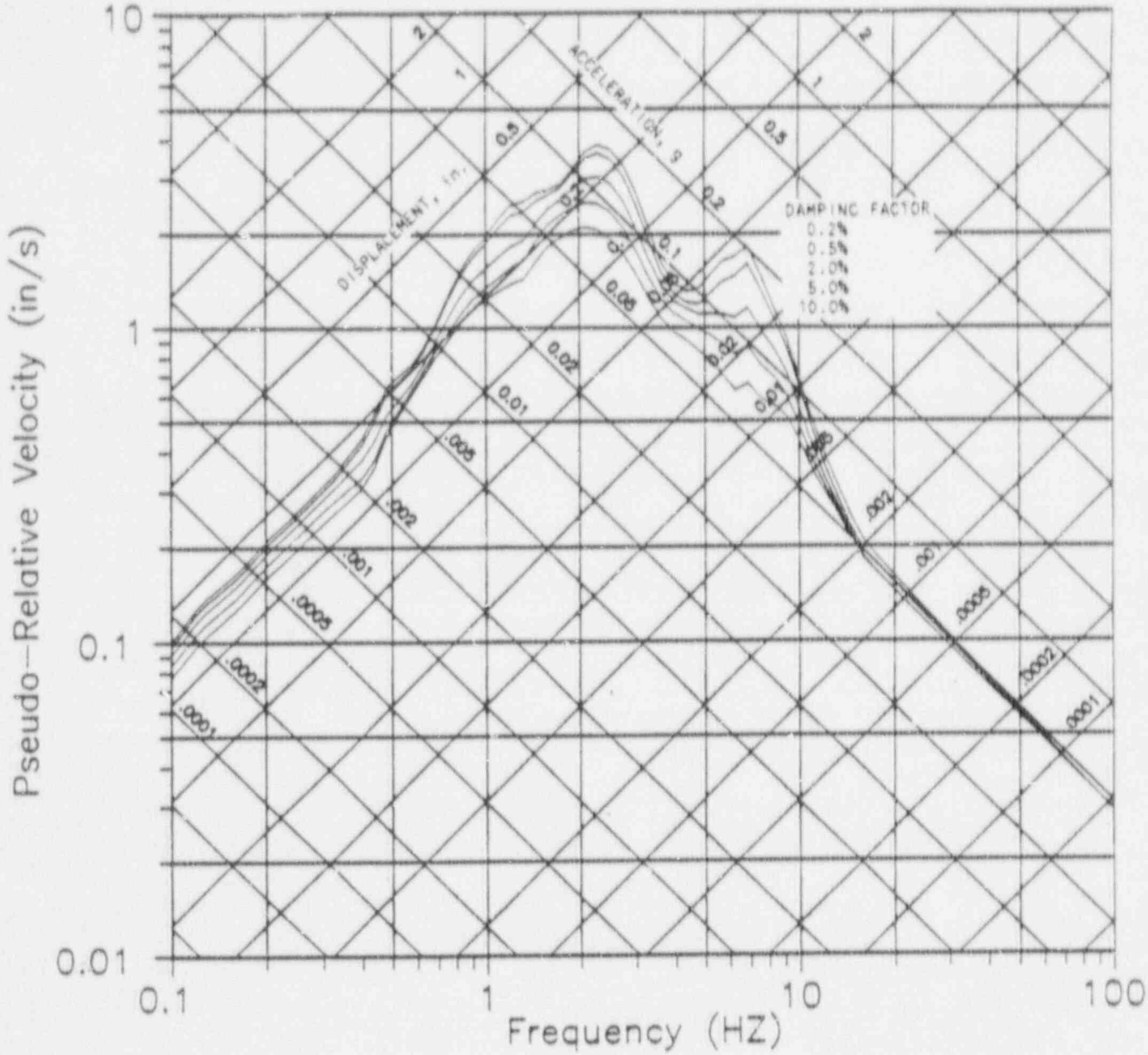
Near-Field Horizontal Response Spectra

Figure 2.4-4



m_b = 5.7
DISTANCE = 105 km

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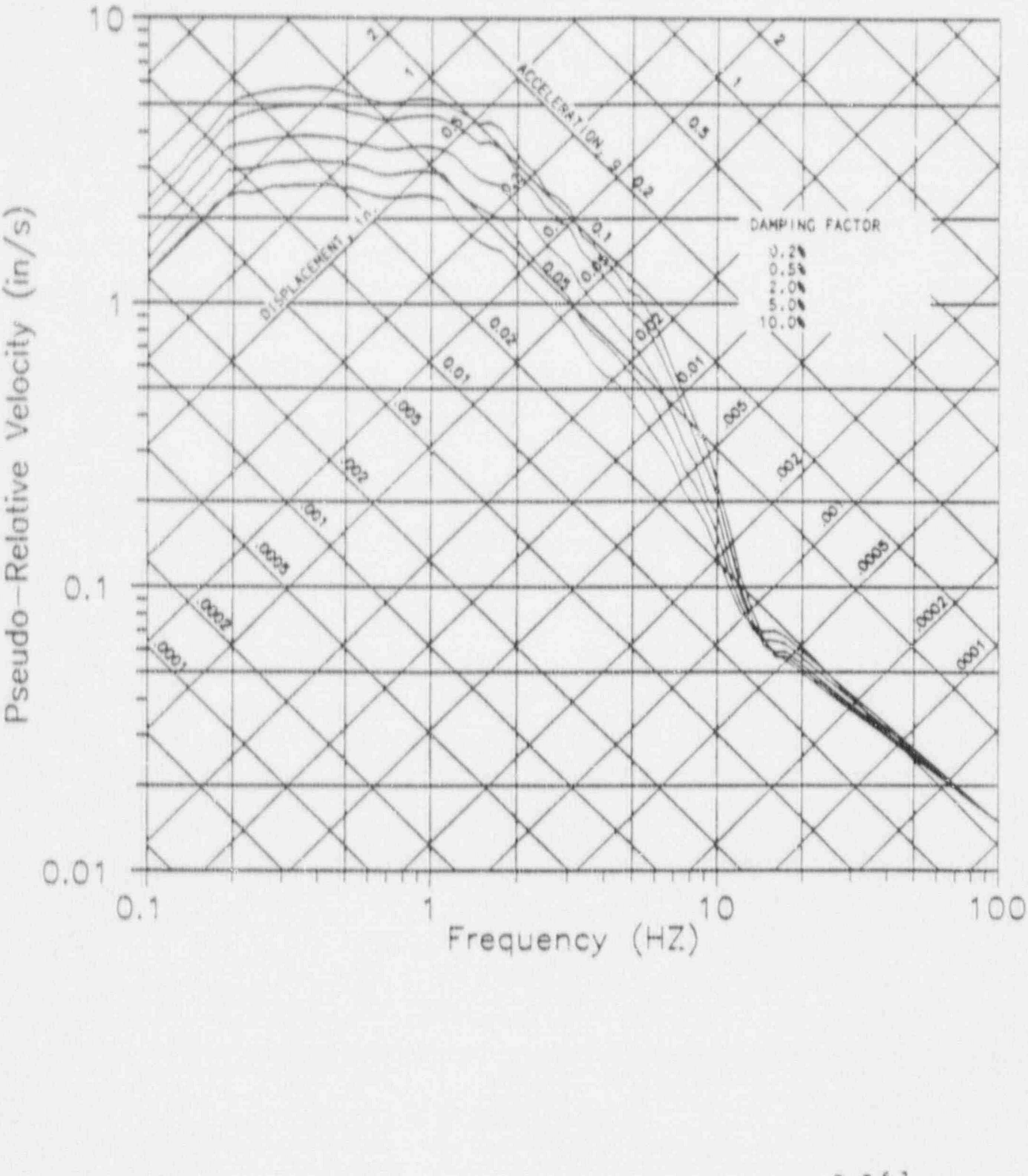
CLAIBORNE ENRICHMENT CENTER

Mid-Field Horizontal Response Spectra

Figure 2.4-5



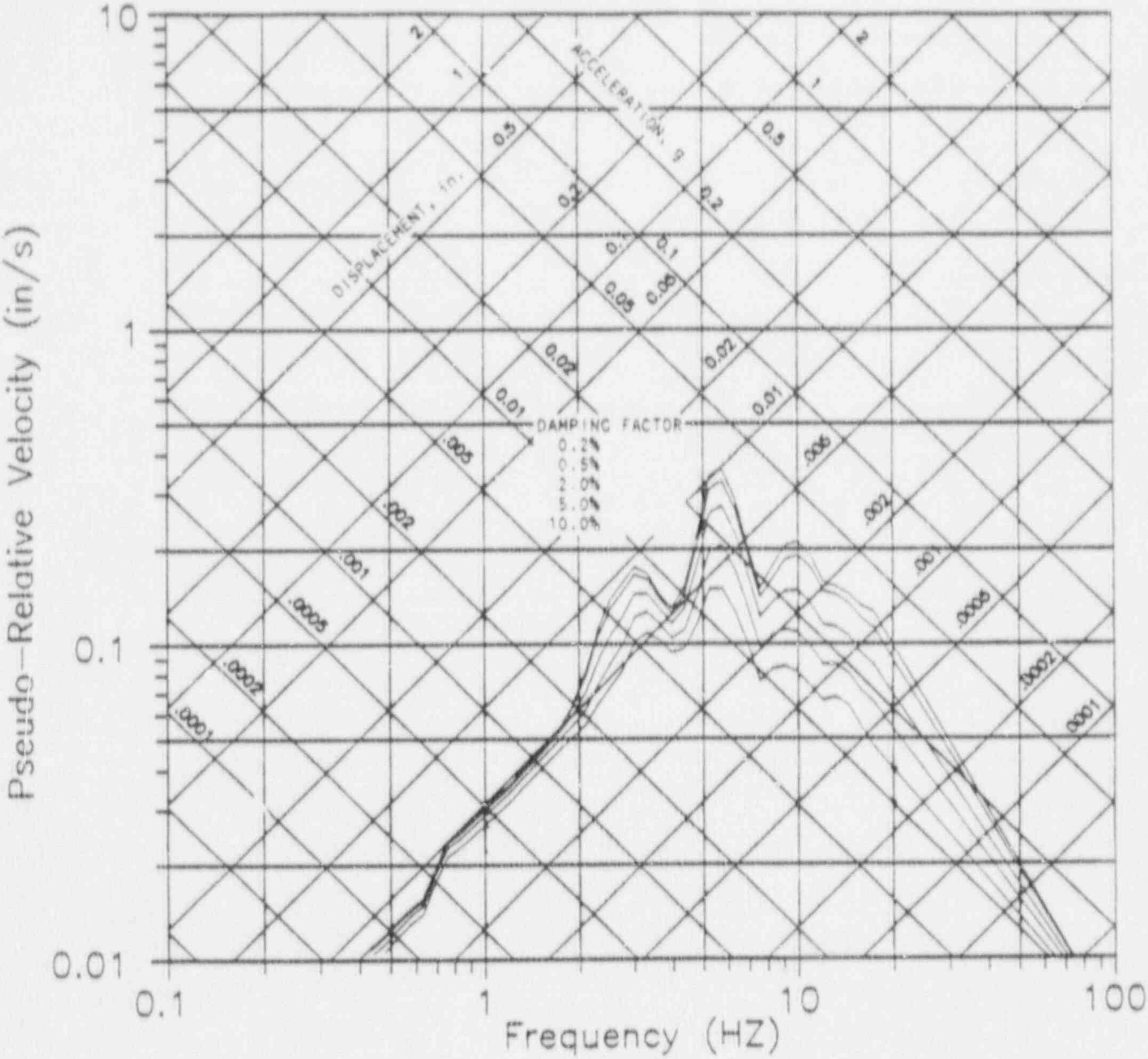
m_b = 6.7
DISTANCE = 365km

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Far-Field Horizontal Response Spectra

Figure 2.4-6



a_0 = 4.3
DISTANCE = 15km

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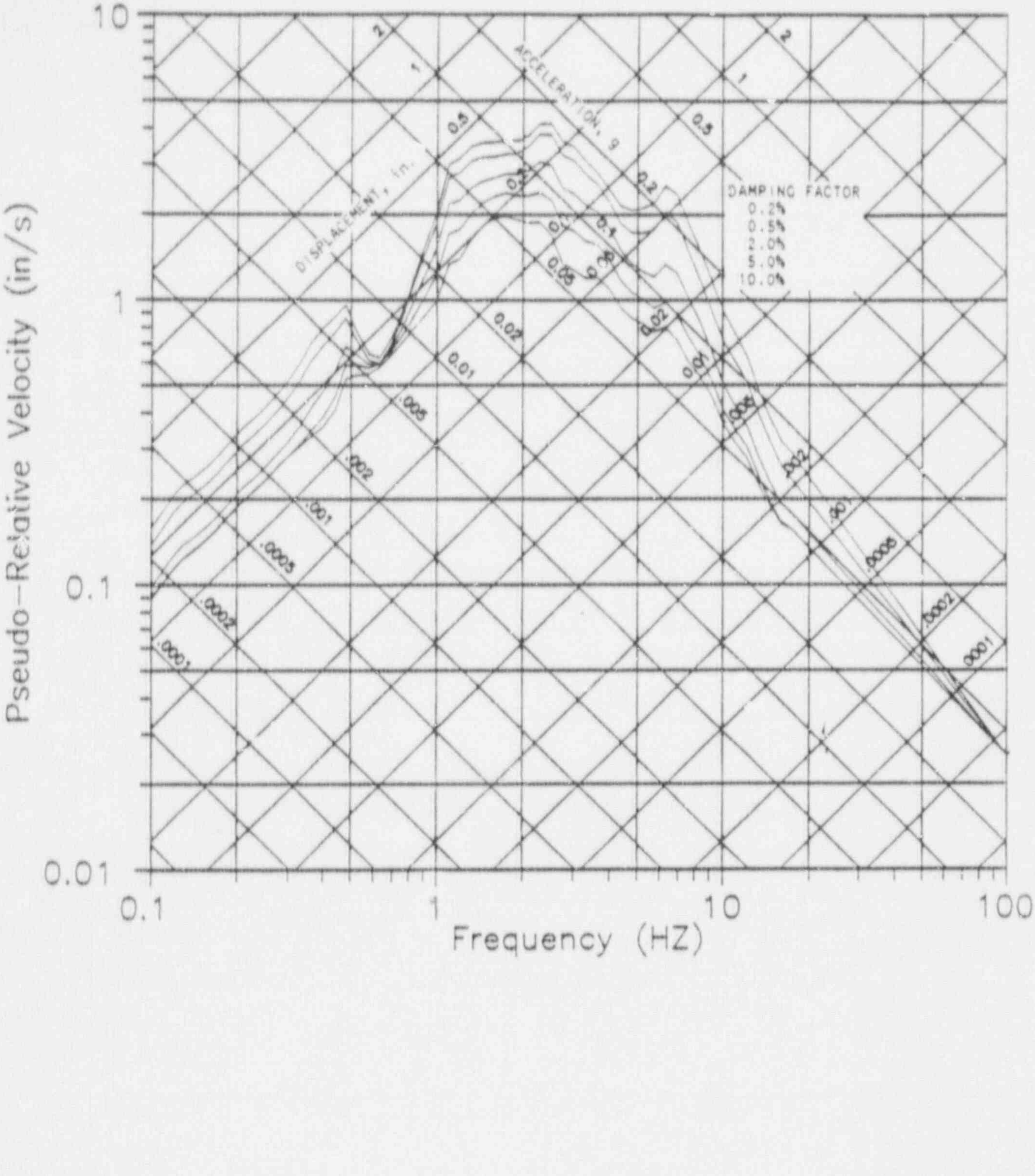
Near-Field Vertical Response Spectra

Figure 2.4-7

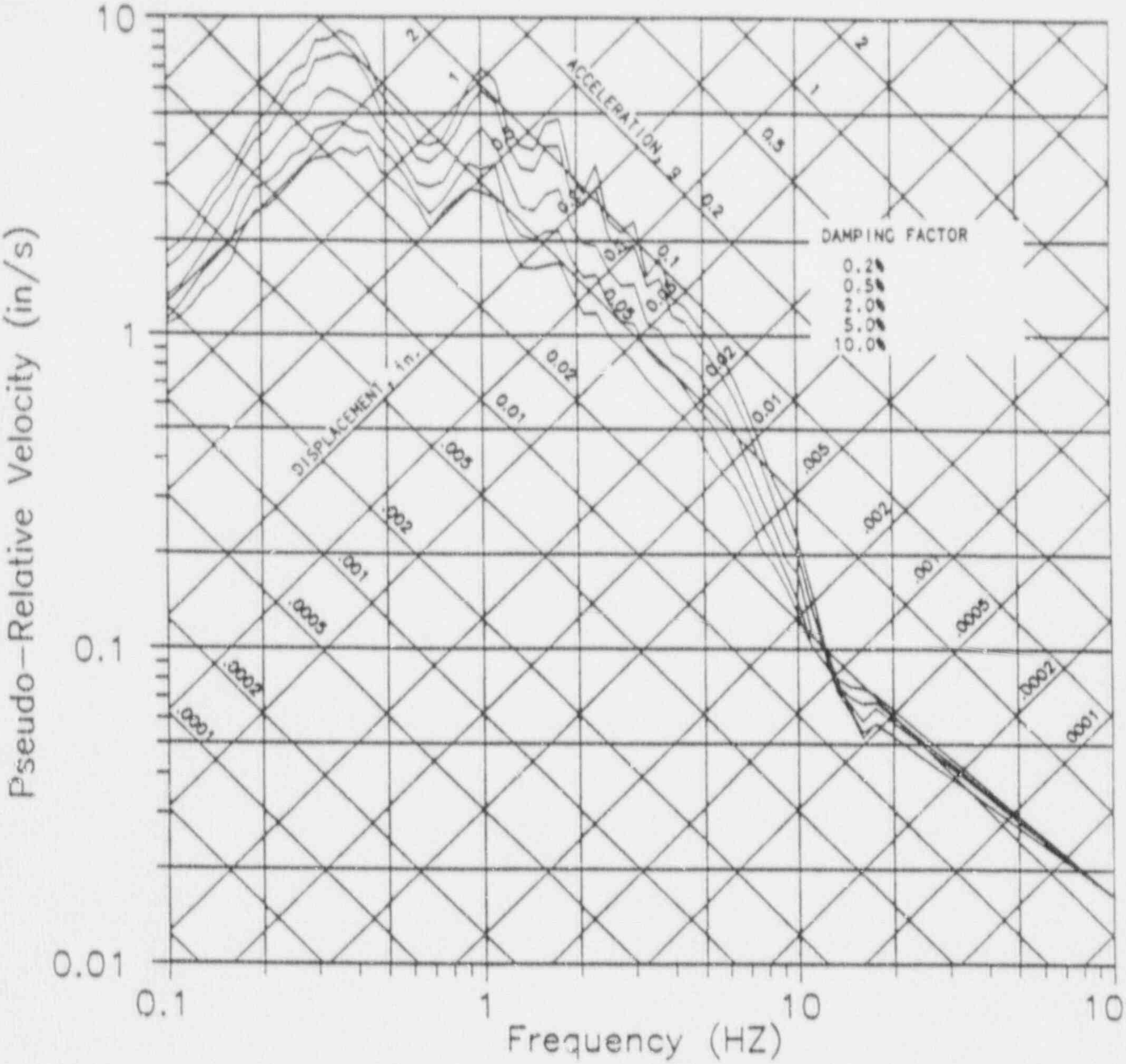


m_b = 5.7
DISTANCE = 105km

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

Mid-Field Vertical Response Spectra

Figure 2.4-8



m_b = 6.7
DISTANCE = 365km

LOUISIANA ENERGY

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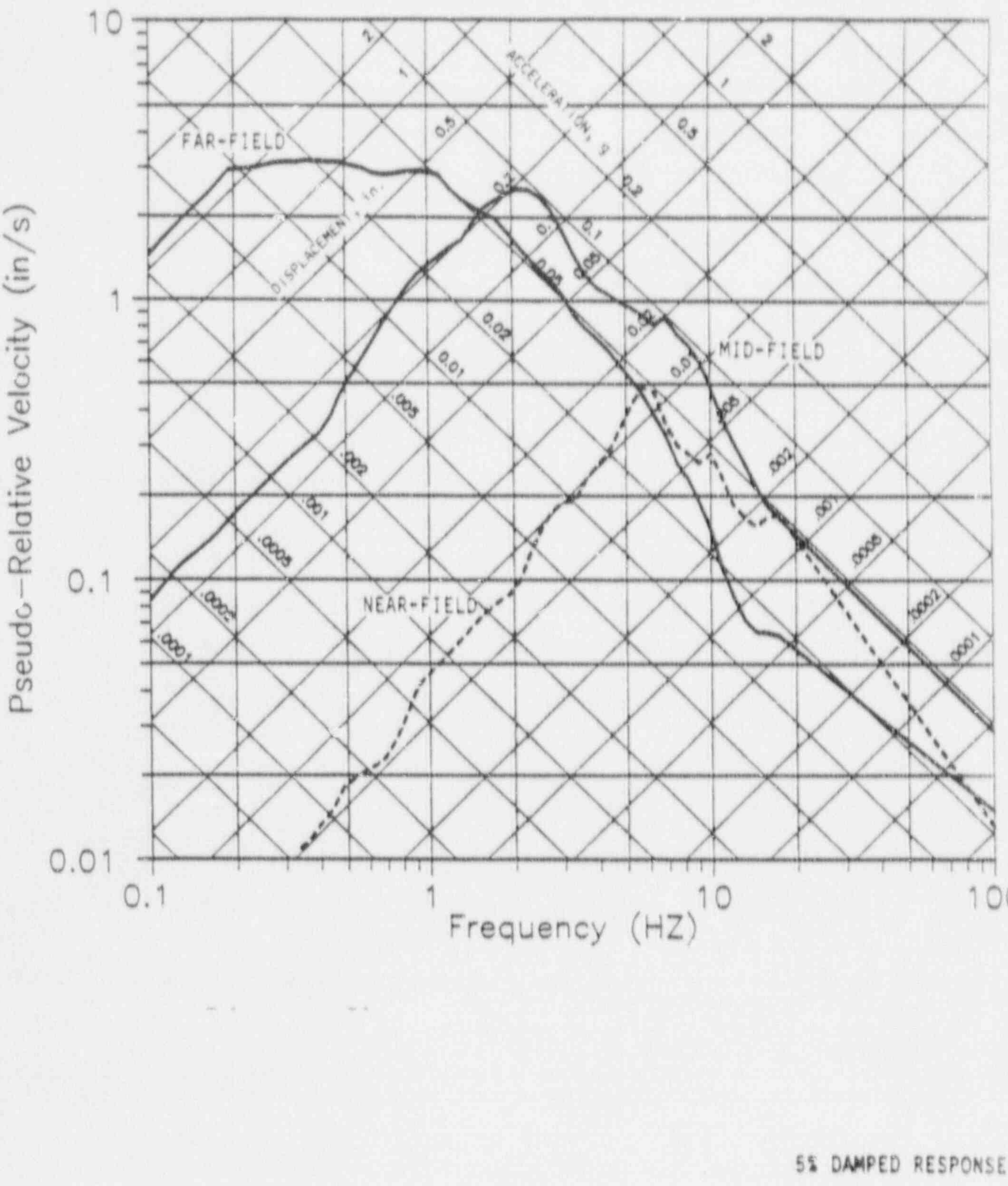
Far-Field Vertical Response Spectra

Figure 2.4-9



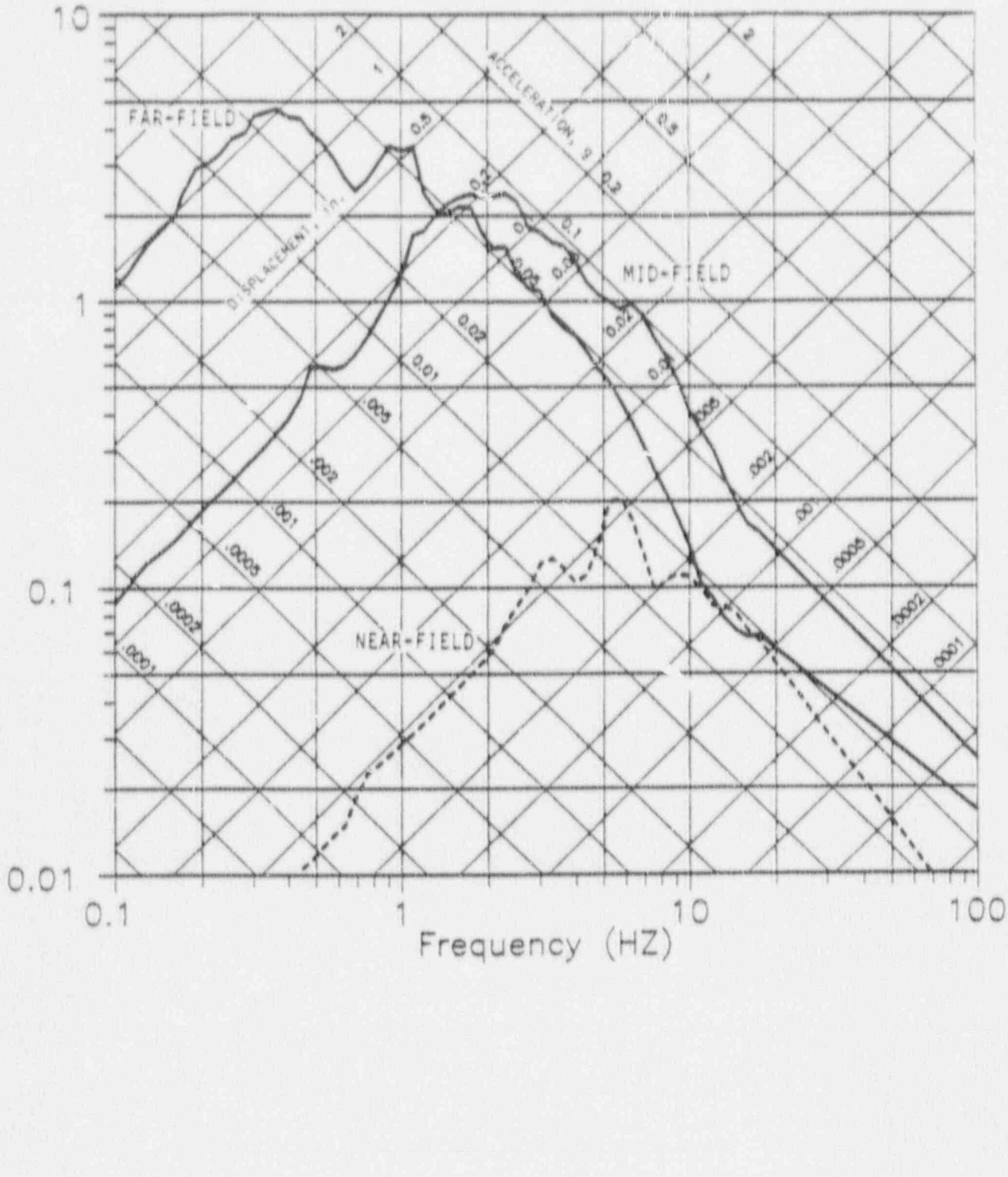
5% DAMPED RESPONSE

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Comparison of
Horizontal Design
Response Data

Figure 2.4-10



5% DAMPED RESPONSE

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Comparison of Vertical Design Response Data

Figure 2.4-11

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2.5 HYDROLOGY

This section addresses the baseline hydrology in the vicinity of the CEC site. The section is divided into two main subsections: 2.5.1 discusses the surface water hydrology; and 2.5.2 discusses the hydrogeology. The baseline information was obtained from literature searches, conversations with various agencies and by conducting site-specific field work.

2.5.1 SURFACE WATER HYDROLOGY

The baseline surface water hydrology is addressed in this section. The general regional surface water hydrology is discussed in Section 2.5.1.1 followed by a discussion of streams and lakes in the vicinity of the CEC site in Section 2.5.1.2 and site-specific surface water hydrology in Section 2.5.1.3. All observations, measurements and analytical results of samples collected during the baseline site investigation are included in Section 2.5.1.2 and 2.5.1.3. This information was collected during an initial site visit conducted in January 1990 and later site visits conducted in May and July of 1990. All reference to land and water elevations are reported in feet relative to the National Geodetic Vertical Datum (NGVD) of 1929.

In Section 2.5.1.4, all current uses of surface water in the vicinity of the site are identified. Potential sources of surface water contamination in the vicinity of the site are addressed in Section 2.5.1.5. Finally, Section 2.5.1.6 addresses potential changes observed in site hydrology during the baseline evaluation as a result of recent timbering activities on the CEC site.

2.5.1.1 Regional Surface Water Hydrology

As illustrated in Figure 2.5-1, the northern portion of Louisiana is drained by two primary river systems. In northwestern Louisiana, streamflow is generally to the south into tributaries of the Red River. In north-central Louisiana, streamflow is generally to the southeast into the Ouachita River and its tributaries, and in northeastern Louisiana, streamflow is generally to the south-southwest into the Ouachita River and its tributaries. In the northern portion of the State, the Mississippi River forms the eastern border of Louisiana.

2.5.1.2 Local Surface Water Hydrology

Figure 2.5-2 illustrates that the major surface water feature in Claiborne Parish is Bayou D'Arbonne. Water flow in Bayou D'Arbonne and its tributaries is generally to the southeast across the parish. Bayou D'Arbonne was dammed in 1966 to create Lake Claiborne which is the largest surface water feature in Claiborne Parish. The lake has a drainage area of 133 sq mi, a normal surface water pool elevation of 185 ft, and a capacity of 100,000 acre-ft at a maximum stage of 9 ft. Discharge from Lake Claiborne is controlled until the water level exceeds the 9-ft stage. Lake Claiborne was created for flood control and conservation; however, the lake adds a recreational attraction to this area of the state.

Surface water that flows off of the CEC site to the west and northwest discharges to Cypress Creek and flows for a distance of approximately 4-1/2 miles where Cypress Creek discharges into Beaver Creek just prior to flowing into Lake Claiborne. At the confluence with Beaver Creek, the area of the Cypress Creek drainage basin is approximately 2×10^8 ft^2 (7.2 mi^2). Surface water leaving the site to the east forms the headwaters for McCasland Creek. The surface water in McCasland Creek flows primarily to the east and eventually discharges into the Middle Fork of Bayou D'Arbonne approximately 12.5 mi downstream of the site. Prior to the confluence with the first major tributary (Greer Creek) the drainage basin for McCasland Creek is approximately 2×10^8 ft^2 (7.2 mi^2).

Table 2.5-1 illustrates seasonal extremes in stream flow recorded at some of the gauging stations in the area. Both Bayou D'Arbonne and the Middle Fork of Bayou D'Arbonne have flow rates which fluctuate greatly and are seasonally dependent. The United States Geological Survey (USGS) gauging station on Bayou D'Arbonne near Dubach, Louisiana (approximately 23 mi east of Homer, Louisiana) has been calculated to have average annual 7-day low flows of 0.0 ft^3/sec with a 10-year recurrence interval and 0.2 ft^3/sec with a 2-year recurrence interval. This data was selected because it represents a 28-year period of record (October 1940 to December 1968) which, with the exception of 2 years, predates the creation of Lake Claiborne. Since outflow from Lake Claiborne is controlled, the majority of this data represents natural discharges. In contrast, the annual peak discharges between 1941 and 1960 at the same station ranged from 2,300 to 26,400 ft^3/sec. Similar extremes were found to occur in the Middle Fork of Bayou D'Arbonne based on data collected at the USGS gauging station near Bernice, Louisiana (approximately 20 mi downstream from the site). Major seasonal fluctuations also are seen at both of these stations. Average monthly minimum discharge rates from mid-summer through late fall (July to November) are most often 0.0 ft^3/sec for 1- and 7-day period with recurrence intervals as low as 2 years. Conversely, the 1- and 7-day average monthly minimum discharge rates with 2-year recurrence intervals for the January to May time period are as high as 253 and 318 ft^3/sec, respectively, at the Dubach Station and 154 and 192 ft^3/sec, respectively, at the Bernice station. The largest average monthly minimum discharge rates occur in either February or March. As discussed in Section 2.5.1.3, similar fluctuations have been identified in the smaller tributary streams on and in the vicinity of the CEC site.

2.5.1.3 Site Specific Surface Water Hydrology

The CEC site is located on a drainage divide. As Figure 2.5-3 indicates, there are two man-made lakes (Bluegill Pond and Lake Avalyn) on the site. Surface water flows off the site in three general directions; to the northeast, southwest, and northwest. During a January 1990 site visit, the discharge of all on-site surface water bodies was observed and estimated to characterize baseline conditions. These observations, along with discharge estimates and measurements made during subsequent site work (May 1990 and July 1990), are summarized in Table 2.5-2.

Lake Avalyn, the larger of the two on-site lakes, is located in the northeastern portion of the property. Discharge from the lake enters a stream that forms the headwaters to McCasland Creek. Discharge from the lake is from an overflow standpipe downstream of the earth dam. During low flow conditions, a gate valve can be opened manually to allow for discharge from Lake Avalyn. Inflow into Lake Avalyn is from precipitation runoff and groundwater discharge. No surface water flows into Lake Avalyn from off site areas. The drainage basin area for Lake Avalyn is approximately 7,343,000 ft^2 (169 acres) and the lake surface area is approximately 6.8×10^5 ft^2 (15.6 acres). During the initial site visit (January 1990), the total observed surface water flow into Lake Avalyn was estimated to be 0.60 ft^3/sec and the discharge from the lake (estimated approximately 1,400 ft downstream of the discharge point) was 2.40 ft^3/sec (See Table 2.5-2). Comparatively, discharge at this same location at the end of July 1990 was 0.07 ft^3/sec. The normal pond elevation of the surface of Lake Avalyn is approximately 296 ft. This elevation is indicated on the 7-1/2 minute topographic map and was also verified during the site investigation.

A bathymetric survey of the lake estimated the volume to be approximately 4.0×10^6 ft^3 (91.8 acre-ft). As indicated in Figure 2.5-4, seven transects were evenly spaced across the width of Lake Avalyn and a final transect was run along the length of the lake. The geometry of these transects (with a 10x vertical exaggeration) is presented in Figure 2.5-5. As illustrated, the deepest and widest portion of Lake Avalyn is at its northern end near the dam. The most gradual slope of the shoreline is encountered along the central section of the lake.

At the end of May 1990, four sediment samples were collected for characterization of the bottom of Lake Avalyn. The samples were collected at evenly spaced intervals down the center of the lake in the vicinity of transects 1, 3, 4 and 6. The sediment sample collected closest the dam was a very hard, dark gray clay. Up-gradient from this area, the sediment became progressively softer and contained increasing amounts of organic matter. The southern-most sampling location (i.e., closest to the main inflow) contained highly unconsolidated dark grayish brown mud.

A large quantity of organic matter, including growing benthic aquatic vegetation, was mixed with this sample.

Bluegill Pond is located on the southwestern portion of the CEC site. Inflow into the pond is from precipitation runoff and groundwater discharge. Two small streams are located at the easternmost portion of the pond. The approximate drainage basin of the Bluegill Pond is 2,816,000 ft^2 (64.6 acres) and the pond has a surface area of approximately 1.1 x 10^5 ft^2 (2.6 acres). The normal pool elevation of Bluegill Pond is 275+2 ft. In January 1990, the total observed surface water flow into Bluegill Pond was 0.47 ft^3/sec and the estimated discharge from the pond was approximately 0.67 ft^3/sec (See Table 2.5-2). In May 1990, the total observed surface water flow into Bluegill Pond was 0.38 ft^3/sec and the estimated discharge from the pond was 0.50 ft^3/sec. The outflow from the pond combines with a stream which flows onto the CEC site from the south. The stream then flows off of the property to the west as a tributary of Cypress Creek.

Data collected during a bathymetric survey of Bluegill Pond indicates that the approximate volume is 7.4 x 10^5 ft^3 (17.0 acre-ft). As indicated in Figure 2.5-6, six transects were fairly evenly spaced across the width of Bluegill Pond and one transect was run along the length of the lake. The geometry of these transects (with a 10x vertical exaggeration) is presented in Figure 2.5-7. Similar to Lake Avalyn, this figure indicates that the deepest and widest portion of Bluegill Pond is located in the vicinity of the dam. The eastern portion of the lake is narrowest and fairly shallow.

Sediment samples were collected at the end of May 1990 from the bottom of Bluegill Pond. The sample locations were evenly spaced down the center of the pond in the vicinity of transects 1, 3, 4 and 6. Sediment near the dam was found to be dark brown to black, high in organic matter and strongly cohesive. A very light brown, one-half inch thick, silty layer, which had recently been deposited, was overlying the sediment. The sediment samples collected up-gradient (i.e., closer to the pond's inflows) were less cohesive and contained progressively more intact organic matter such as leaves. The light brown silty layer thinned towards the inflows and stratification between the silty layer and the underlying sediment became less pronounced.

Prior to discharge from the site, a small tributary that drains an area south of the site converges with the flow from Bluegill Pond. Near the property boundary, the discharge in this stream was approximately 1.90 ft^3/sec in January 1990 and 0.22 ft^3/sec at the end of July 1990.

On the northwestern portion of the CEC site, a small tributary flows off the site into Cypress Creek. Near the property boundary, the drainage basin for this stream is estimated to be

2.6×10^6 ft^2 (59.7 acres). At the time of the initial site visit (January 1990), the discharge was estimated to be 0.32 ft^3/sec, while during the next visit, at the end of July 1990, only standing water was observed in the area. No surface water flows into this stream from off-site areas before it leaves the property.

As initially discussed in Section 2.5.1.2, streamflow fluctuations near the CEC site mimic those in the larger streams and rivers further down-gradient. The measured discharge rate from Lake Avalyn outflow decreased one and a half orders of magnitude between January 1990 and July 1990. Similarly, the discharge in the outflow of Bluegill Pond (after its confluence with the tributary from the southwest) decreased by almost an order of magnitude between January 1990 and July 1990. Further, by early August 1990, downstream reaches of both McCasland and Cypress Creeks were dry indicating that they had become losing streams in these areas. Under continuing low precipitation conditions, it is possible that groundwater would no longer support baseflow even for on-site sections of the tributaries. In this case, the flow in these streams would cease.

A Hold-up Basin will be constructed near the southwest corner of the plant yard by placing an earthen embankment across a natural depression in the area topography. The Basin is located hydraulically up-gradient from the Bluegill Pond. The Hold-up Basin is unlined and has a normal pond elevation of 300+0.

The primary function for the Hold-up Basin is to perform as a sedimentation basin during the plant construction. The Hold-up Basin will also function as runoff surge control for the CEC.

Pertinent information concerning the Hold-up Basin and dam are contained in Table 2.5-3 and Figure 2.5-8.

The outlet works for the Hold-up Basin consists of a riser and barrel arrangement for the service spillway and a concrete weir for the emergency spillway. The riser for the service spillway is a concrete structure with water levels controlled by stoplogs. The barrel is a 36 inch diameter concrete pipe approximately 150 ft long with an invert elevation of 278+0. The emergency spillway consists of a concrete weir approximately 30 ft long at an elevation of 304+0 located on the west side of the Hold-up Basin. Discharge over the weir is routed to Bluegill Pond. A stone lined channel routes the discharge around the Hold-up Basin embankment. Details of both the service and emergency spillways are shown in Figure 2.5-9.

In order to achieve acceptable settling efficiency, the service spillway is designed to limit the discharge velocity from the Hold-up Basin. The following design parameters are utilized in determining the limiting discharge velocity:

Design Storm	25-year storm
Design Particle Size	40 microns (400 mesh sieve opening)
Design Particle Specific Gravity	2.6

Based on the design parameters, the limiting discharge velocity for acceptable settling efficiency is approximately 290 cfs (Reference 33).

In addition to limiting discharge velocity for settling efficiency, the outlet works will function as runoff surge control for the CEC. The service and emergency spillways are designed for the 25-year storm and the Standard Project Flood (SPF), respectively. In the design of the emergency spillway, the SPF is assumed to equal 68% of the Probable Maximum Flood (PMF).

2.5.1.3.1 Surface Water Chemistry

2.5.1.3.1.1 Stream and Lake Chemistry

Water chemistry samples were collected from several on-site shallow streams and from the two on-site lakes during May 22 and 23, 1990, and analyzed for chemical properties. Two additional samples were collected from the Cypress Creek drainage basin downstream of Bluegill Pond on August 1, 1990. Tables 2.5-4 and 2.5-5 present surface water quality data. The sample locations are identified in Figure 2.5-10.

As indicated in Figure 2.5-10, five unfiltered water samples were collected from within the Lake Avalyn drainage basin. A sample of the primary inflow to the lake was collected at the southernmost end of Lake Avalyn, two samples were collected from the lake itself (from the surface and bottom); a surface water sample was collected from the pool of water near the base of the overflow standpipe from the lake; and an additional sample of the discharge from the lake was collected approximately 1,200 ft down-gradient of the outflow. A summary of the water chemistry presented in Table 2.5-4 follows:

a. Of all sampling locations, the maximum concentrations of magnesium, sodium, cadmium, chromium, lead, sulfate, total organic carbon, chloride and zinc were present in the sample from the inflow to Lake Avalyn.

b. The maximum concentrations of mercury, copper and total phosphorus were present in the sample collected from the bottom of Lake Avalyn.

c. Silver, beryllium, antimony, thallium, selenium, nitrite, nitrate and nickel were not detected in any of the water samples from the Lake Avalyn drainage basin.

d. Little variation in the concentrations of calcium, potassium and hardness was observed, although the lowest concentration of potassium was in the sample collected from the surface of Lake Avalyn.

e. The maximum concentration of calcium carbonate ($CaCO_3$) hardness was in the outflow sample collected furthest from the site.

f. The maximum concentration of total suspended solids was found in samples from the inflow and outflow.

g. Arsenic was only detected in water samples collected from the bottom of the lake and the outflow. However, it was not detected in the other samples at similar or higher detection limits.

h. Ammonia nitrogen was only detected in the outflow sample collected furthest from the lake.

As indicated in Figure 2.5-10, four unfiltered water samples were collected from within the drainage basin to Bluegill Pond during May 1990. These were: the inflow stream to Bluegill Pond, located at its eastern end; the surface and bottom of Bluegill Pond; and the outflow from Bluegill Pond. Additionally, a stream water sample was collected from the stream to the southeast of Bluegill Pond during May 1990. This stream drains the oil/gas well site and converges with the outflow from Bluegill Pond before it discharges from the CEC site. In August 1990, two additional water samples were collected from the Cypress Creek drainage basin. A summary of the water chemistry presented in Table 2.5-5 follows:

a. Of all sampling locations, the maximum concentrations of cadmium and sulfate were present in the inflow to Bluegill Pond.

b. Maximum concentrations of potassium were present in the surface water sample from Bluegill Pond and from the outflow from Bluegill Pond.

c. The maximum concentration of total suspended solids was present in the sample collected from the outflow from Bluegill Pond.

d. The maximum concentration of copper was detected in a sample collected from the bottom of Bluegill Pond.

e. The maximum concentrations of calcium carbonate $CaCO_3$ hardness, chloride and ammonia nitrogen were present in water samples collected from the stream that drains the oil/gas well site.

f. The lowest concentration of total phosphorus was detected in the sample from the inflow to the pond.

g. The lowest concentration of magnesium was detected in the sample collected from the bottom of Bluegill Pond.

h. The lowest concentrations of zinc, chromium, nickel and total organic carbon were present in samples collected from the stream that drains the oil/gas well site.

i. There was not much variability observed in the concentrations of calcium, arsenic or lead in any of the water samples.

j. Silver, beryllium, antimony, mercury, thallium, selenium and nitrite were not detected in any of the water samples collected from Bluegill Pond drainage basin.

k. Maximum concentrations of calcium, magnesium, nickel and calcium carbonate (hardness) were present in the surface water samples collected from Cypress Creek 1.5 mi downstream from Bluegill Pond in August 1990.

2.5.1.3.1.2 Physicochemical Lake Profiles

Physicochemical data was collected from the two on-site lakes during two sampling events. The first sampling event was on January 20, 1990 before timbering activities began at the site. The second sampling event was conducted near the end of the timbering activities on May 22, 1990. There had been heavy rainfall during the week preceding the January 1990 sampling event and there was constant rainfall throughout much of the day that the lakes were sampled. High water conditions were observed during this sampling event, as large volumes of water were discharging from both lakes during this time period. Data collected from the lakes is presented in Table 2.5-6.

Thermal stratification of lakes of this size is common during the winter in northern Louisiana. In late December 1989, a thin sheet of ice was observed on each of the on-site lakes. Therefore, it is apparent from the temperature data in Table 2.5-6 that the recent precipitation had caused some erosion of the winter thermal stratification of the lakes. When ice formed on these lakes, the bottom water temperature at this time would be equal to the temperature at which the water is at its maximum density, or 4 C. Table 2.5-6 shows that the surface water temperature in Lake Avalyn was 11 C and the temperature at the bottom was 9 C. In Bluegill Pond, the surface water temperature was 10.5 C and the bottom temperature was 6.5 C. In both lakes dissolved oxygen decreased with depth and conductivity was constant or nearly constant over the depth measured. The other parameters measured were considered to be low for both lakes.

The pH of 5.3 in Lake Avalyn may have been due to a combination of factors such as: input of acidic precipitation; reduced photosynthetic activity; and pine litter layer in and around the drainage basin. The low alkalinity indicates these lakes have little buffering capacity. The turbidity in Bluegill Pond was higher than in Lake Avalyn. This may have been due to the fact that there is greater topographic relief within the drainage basin to Bluegill Pond and recent precipitation may have eroded and transported sediment into the lake.

Table 2.5-6 shows that by May 22, 1990 both lakes were thermally stratified and low dissolved oxygen concentrations in the bottom of these lakes indicates that at least the bottoms of these lakes become fairly anoxic in the summer. The major differences observed in these two lakes during this sampling event are the Secchi Disk reading (a measure of transparency) and the turbidity. Lake Avalyn had a Secchi Disk reading of 43 inches and the turbidity was 2.6 NTU. However, Bluegill Pond only had a Secchi Disk reading of 11 inches and the turbidity was 48 NTU, indicating that there is a large amount of suspended material in Bluegill Pond. This is probably because the recent deforestation was much more intensive in the drainage basin to Bluegill Pond than in the drainage basin to Lake Avalyn. Additionally, the drainage basin to Bluegill Pond is more steeply sloped allowing for more rapid runoff of precipitation and erosion and transport of sediment into the lake.

2.5.1.4 Surface Water Use in the Vicinity

As discussed in Section 2.5.1.2, the predominant surface water feature in the vicinity of the CEC site is Lake Claiborne. Lake Claiborne was dammed for flood control and conservation and is used extensively for recreational purposes including swimming, boating, water skiing, and fishing. Lake Claiborne is not, and has never been, used as a source of public water supply (Reference 1). Numerous creeks also exist in the area, of which the most immediate to the CEC site are Cypress and McCasland Creeks. In the vicinity of the CEC site, human use of these creeks was not identified. However, it is possible that children living in the area may play in the creeks. In addition, small herds of cattle are raised by residents living along downstream reaches of both Cypress and McCasland Creeks. In some cases, these creeks are used for watering the livestock.

2.5.1.5 Potential Sources of Surface Water Contamination

The following agencies were contacted for assistance in identifying potential sources of surface water contamination in the vicinity of the CEC:

- The Louisiana Water Resources Information Center
- The Claiborne Parish Public Health Department

- The U.S. Geological Survey
- The U.S. Army Corps of Engineers
- The U.S. Forest Service
- The U.S. Environmental Protection Agency
- The Louisiana Department of Wildlife and Fisheries
- The Louisiana Statewide Flood Control

In addition, initial studies performed for the CEC site were also reviewed (Reference 2 and 3).

Few potential sources of surface water contamination exist in close proximity to the CEC site. Most notable is the oil and gas well located to the south of the southwestern corner of the site. In October of 1989, samples were collected of soil (surface and composite subsurface), surface water and sediment in an effort to determine whether contaminants potentially associated with the oil and gas well have migrated onto the CEC site (Reference 2). In addition, up-gradient (background) surface water and sediment samples were collected. All of the samples were analyzed for benzene, ethylbenzene, toluene, xylenes (BETX), total petroleum hydrocarbon (TPH), and priority pollutant metals. None of the samples in any of the media were found to contain BETX above the laboratory detection limits. Similarly, detected concentrations of priority pollutant metals in soil and sediment samples were within levels commonly found in soils. While concentrations of priority pollutant metals were reportedly within common natural ranges for all surface water samples collected from locations which were considered down-gradient from the oil and gas well, the background surface water sample was found to contain 0.06 mg/l of silver. TPH was not found in any of the surface water samples, but was detected above the laboratory detection limit in all of the soil and sediment samples except for the composite subsurface soil sample. Detected concentrations of TPH in the soil and sediment samples ranged from 20 to 104 parts per million (ppm). The background sediment sample was found to contain 91 ppm of TPH. Because no other potential sources of contamination have been identified in the vicinity of the southern edge of the CEC site, it is likely that the detected concentrations of TPH in the soil and sediment samples are a result of migration from the oil and gas well property. The presence of TPH in the background sample could indicate that this sampling location was not sufficiently up-gradient from the oil and gas well to avoid impact. The continued migration of contaminants to and subsequently in the stream would transport the contaminants across the southwest corner of the site and potentially into Cypress Creek.

2.5.1.6 <u>Potential Changes in Baseline Hydrology as a Result of Site Timbering Activities</u>

Many field studies have been conducted to evaluate the potential physical and chemical effects of deforestation on surface water streams. Patric (Reference 4) has shown that in a small watershed in an area with an average rainfall of 57 in/year (similar to that at the site), streamflow was observed to increase 10 in/year as a result of deforestation. Soil moisture was higher and larger instantaneous peak flows were observed during small storms during the growing season. Because rainfall infiltrated more readily into moist soil, the water level in the streams was maintained at consistently higher levels. Patric (Reference 4) reported that this increase in streamflow is not expected to be measurable in larger streams. Thus, it is likely that some increase in stream flow in the on-site streams is occurring in response to storm events during the baseline evaluation, but that this increase will have little effect on the larger streams down-gradient of the CEC site.

McClurkin and Moehring (Reference 5) reported that deforestation creates the potential for either increases or decreases in soil water. Due to decreases in evapotranspiration, more water is available for recharge. However, logging activities compact the soil and destroy the soil structure. This compaction acts to reduce soil water because infiltration is restricted and surface runoff increases. Overland flow may result in saturated areas initiating sheet and rill erosion. The observed intensity and duration of this effect are dependent on the rate of regrowth at a site. Sediment loss through erosion was found to decline rapidly after the first year. At the CEC site, regrowth is occurring rather rapidly, and sediment transport into Bluegill Pond already has decreased notably, five months following the start of timbering.

The most significant change in surface water chemistry following deforestation has been found to be primarily due to increased sediment transport into streams. Patric and Reinhardt (Reference 6) reported that little variation in specific conductance in surface water streams over time was observed before deforestation. However, specific conductance almost tripled in streams which drained watersheds that had been deforested. The greatest increase in specific conductance was found along the longest deforested reach of the channel. Surface water turbidity also was found to increase in areas that had been deforested.

In estimating the potential effects of deforestation on surface water, McClurkin et al. (Reference 7) calculated discharge weighted concentrations of sediment and nutrients in streams. In their study, clear cutting of the areas studied was done carefully to minimize erosion and soil compaction. For the nutrients that were monitoring, it was observed that overall inputs of these nutrients through precipitation were greater than the losses during stormflows. From this finding, McClurkin concluded that there is no significant impact on water quality if recommended harvesting practices are observed. There likely was an impact on water quality at the CEC site, because timbering performed by the previous property owner was not conducted in a manner to minimize erosion and soil compaction.

In a study reported by Likens (Reference 8), vegetation in the study area was cut but not removed and herbicides were applied to prevent regrowth of vegetation. Stream flow runoff was found to increase by 40% the first year, 28% the second year and 26% the third year after deforestation. An increase in all major chemical ions was observed in the stream flow with the exception of ammonium and sulfate which decreased, and bicarbonate which remained about the same. The nitrogen cycle was altered and during the first year a 41% increase in the net export of nitrogen was observed. This was presumably from increased microbial nitrification from decomposing organic matter. Additionally, a nine times increase in particulate matter output was observed. Likens (Reference 8) concluded that deforestation can accelerate eutrophication in downstream aquatic ecosystems.

The CEC site was timbered by the previous property owner by clear cutting during the winter and early spring of 1990. Following deforestation, vegetation in some areas was cleared completely, while in other areas the litter layer, undergrowth, and trees having a small diameter were left relatively undisturbed. The most significant identified impact following deforestation was the transport of sediment into Bluegill Pond. The pond water was observed to be very turbid and brown in color shortly after trees were removed from up-gradient areas of the drainage basin. Data from a general aquatic survey conducted January 20, 1990, showed the turbidity of Bluegill Pond to be 8.2 NTU. However, in May 1990, after the site had been timbered, the turbidity of Bluegill Pond was 48 NTU. Timbering had a much less drastic impact on Lake Avalyn because trees were not removed from areas as close to the shoreline as they were for Bluegill Pond. In addition, the topography within the drainage basin for Lake Avalyn is more gently sloped than around Bluegill Pond. These combined factors resulted in less erosion and transport of sediment into Lake Avalyn. The average turbidity of Lake Avalyn in January 1990, before the timbering began, was 2.5 NTU, and in May 1990 the turbidity was 2.6 NTU. Additionally, Secchi Disc readings taken on May 23, 1990 were for 43 inches in Lake Avalyn and only 11 inches in Bluegill Pond.

As indicated in Table 2.5-6 conductivity measurements made January 20, 1990, showed little variation with depth, being 19 and 20 μmhos/cm in Lake Avalyn and 28 μmhos/cm over the entire measured depth of Bluegill Pond. However, on May 23, 1990, the conductivity of the water in Lake Avalyn showed a steady increase with depth, from a low of 15 μmhos/cm to a maximum of 55 μmhos/cm at the deepest location of 15 ft. Conductivity measurements were higher in Bluegill Pond than Lake Avalyn in May 1990. A steady increase in conductivity with depth also was observed in Bluegill Pond, with a low of 33 μmhos/cm at the surface and 1 ft below the surface, and a maximum of 94 μmhos/cm at a depth of 12 ft.

Overall, the impact of timbering portions of the site by the previous land owner on the surface water hydrology does not appear to be extreme and indications are that the impact will be temporary. Within five months of the start of timbering activities, vegetation has grown over the majority of the disturbed areas and Bluegill Pond appears to have a lesser amount of suspended sediment and is clearing. Thus, it appears that this regrowth has already helped diminish erosion and transport of surface soil.

2.5.2 GROUND WATER HYDROLOGY

This section includes a discussion of the hydrogeology beneath and in the vicinity of the CEC site. The regional hydrogeology is discussed in Section 2.5.2.1 to define the regional aquifers to be addressed by this study. The local hydrogeology of the important aquifers identified is discussed in Section 2.5.2.2. In Section 2.5.2.3, the site hydrogeology is defined. This discussion focuses on the uppermost saturated zone beneath the site and presents all information developed during the site investigation, such as the direction of groundwater flow, the groundwater velocity and groundwater chemistry. All identified uses of groundwater in the vicinity of the site are presented in Section 2.5.2.4 and potential sources of groundwater contamination are discussed in Section 2.5.2.5. The discussion of groundwater hydrology ends with a presentation in Section 2.5.2.6 of potential effects that may be observed during the baseline evaluation as a result of timbering activities at the site.

The information presented in this section was obtained by conducting literature searches using the U.S. Geological Survey GWSI Database, the STORET Database, the GEOREF Database, Water Resources Abstracts Database and the Louisiana Water Data Directory. In addition the following agencies were contacted for specific information: The Louisiana Water Resources Information Center; the U.S. Geological Survey; the U.S. Environmental Protection Agency; the Louisiana Department of Environmental Quality; The Louisiana Department of Health & Hospitals; the Louisiana Department of Transportation and the Claiborne Parish Public Health Department.

2.5.2.1 <u>Regional Hydrogeology</u>

Northern Louisiana is located within the Gulf Coast Physiographic Province. This area is underlain by sedimentary units that generally dip and thicken to the southeast (Reference 9). Four geologic units in this area contain regional aquifers. As illustrated in Table 2.5-7, the geologic units are: the Wilcox Group; the Carrizo Sand; the Sparta Sand; and the Cockfield

Formation. The Wilcox Group and the Carrizo Sand are hydraulically interconnected and are treated as the Wilcox-Carrizo aquifer. The Wilcox-Carrizo aquifer is separated from the Sparta aquifer by the Cane River Formation. The Cane River Formation is mostly clay and acts as a confining layer. The Cook Mountain Formation is predominantly silty clay and confines ground water in the Sparta aquifer. In some areas, groundwater in the Cook Mountain Formation may provide a source of water for domestic wells (Reference 10). The Cockfield aquifer overlies the Cook Mountain Formation and groundwater in the Cockfield Formation may occur under water table conditions. Although not considered to be regional aquifers, where they are present, the upland terrace and alluvial deposits also may contain groundwater under water table conditions. A discussion of the expected properties of the above mentioned stratigraphic units on a more local scale follows.

2.5.2.2 Local Hydrogeology

A water resource report is not currently available for Claiborne Parish, Louisiana. However, a study has been conducted for the Sparta Sand in the Claiborne Parish area and the report is under internal review at the United States Geological Survey (USGS). The report will be released upon completion of the review (Reference 11). Personnel at the USGS in Ruston, Louisiana have reported that the stratigraphy in Claiborne Parish is very similar to that described for the western part of Union Parish, Louisiana (Reference 12). Therefore, the water resource report for Union Parish (Reference 10), located to the east of Claiborne Parish, is used as a key reference for defining the hydrogeology in the vicinity of the CEC site. Additionally, other reports that address the northern Louisiana salt dome study area have been used to obtain information. The salt dome study area is an area of about 3,000 sq mi with the CEC site located just to the northwest of the central portion of the study area. The stratigraphic units considered to be of importance in defining the hydrogeology in the vicinity of the CEC site are discussed below from oldest (deepest) to youngest.

2.5.2.2.1 Wilcox-Carrizo Aquifer

The Wilcox-Carrizo aquifer consists of fine to medium sand that is interbedded with clay and silt. This hydrologic unit is 500 to 1000 ft thick and contains freshwater and saltwater. While wells with large water supplies may be developed where the sands are thick, this aquifer is mostly penetrated by small-yielding wells. The hydraulic conductivity of this aquifer is reported to range from 15 to 25 ft/day (Reference 13). Plate 2 in Ryals (Reference 9) shows the altitude of the base and the thickness of the Wilcox-Carrizo aquifer as well as the approximate downdip limit of freshwater in the Wilcox-Carrizo aquifer. This plate indicates that the Wilcox-Carrizo aquifer contains salt water beneath the majority of Claiborne Parish, and that this stratigraphic unit is approximately 250 to 500 ft thick beneath Claiborne Parish. Closer to the vicinity of the site (township 21N, range 6W), the base of the Wilcox-Carrizo aquifer is located at an elevation of approximately -1100 ft relative to the National Geodetic Vertical Datum of 1929 (NGVD). The area located approximately 5 to 10 mi west/southwest of the site has undergone faulting and the base of the Wilcox-Carrizo aquifer at this location has been displaced upwards to approximately -600 ft NGVD. Law (Reference 18) reports that faulting in Claiborne Parish has not been active since the Middle Tertiary (approximately 25 million years ago).

Because the Wilcox-Carrizo aquifer contains salt water in the area of interest, it has not been developed as a water supply in the vicinity of the CEC site. The Wilcox-Carrizo aquifer does not have the potential to be developed in the future. Therefore, the aquifer will not be addressed further in this report.

2.5.2.2.2 Cane River Formation

The Cane River Formation is mostly composed of clay and is approximately 200 to 300 ft thick (Reference 13). Plate 6 in Ryals (Reference 9) shows that beneath most of Claiborne Parish the base of the Cane River Formation is at an altitude of -750 ft relative to NGVD, except in the faulted area 5 to 10 mi west/southwest of the site where the base is at an elevation of -250 ft NGVD. The Cane River Formation acts as a confining layer and retards movement of water between the Wilcox-Carrizo and Sparta aquifers.

2.5.2.2.3 Sparta Aquifer

The Sparta aquifer is the principal aquifer of north-central Louisiana. The Sparta Sand is composed of alternating layers of very fine to medium sand, silty clay, lignite and lesser amounts of clay. The lithology of the Sparta Sand has been found to be highly variable both vertically and laterally. Because the sediments comprising the Sparta Sand were deposited by shifting streams on a deltaic-fluvial flood plain, individual sands cannot be traced over long distances (Reference 10). The Sparta aquifer contains both freshwater and saltwater. Fresh groundwater is withdrawn by domestic, municipal and industrial wells.

Plate 3 in Ryals (Reference 14) indicates that in the vicinity of the CEC site (township 21N, range 6W), the Sparta Sand is 400 to 600 ft thick, with the altitude of the base of the Sparta aquifer between -400 to -500 ft relative to NGVD. In the site area, the Sparta aquifer is reported to contain both freshwater and saltwater. Ryals (Reference 13) shows that in the vicinity of the CEC site, the altitude of the base of fresh ground water is approximately -400 ft relative to NGVD. Payne (Reference 15) indicates that the maximum sand unit thickness in the vicinity of the CEC site is 150 ft. A review of boring logs from water supply wells in the vicinity of the site indicates that the total thickness of sands in the Sparta aquifer ranges from 99 ft to 303 ft. This information is summarized in Table 2.5-8 and the locations of the wells are shown in Figure 2.5-11. None of these wells were drilled through the entire thickness of the Sparta, therefore, the exact total thickness of sands is not known. However, this data illustrates the discontinuous nature of the sand layers in the Sparta Sand. The maximum single thickness of a sand unit encountered in the Sparta was 126 ft in well CL-163B.

As mentioned in Section 2.5.2.2.1, the area located approximately 5 to 10 mi west/southwest of the site underwent faulting prior to and during the Middle Tertiory (approximately 25 million years ago). At this location, the base of the Sparta aquifer has been displaced upwards to approximately -200 ft NGVD. The Sparta Sand outcrops in this area, and its thickness has been reduced to 200 to 400 ft thick. In this area, the elevation of the base of fresh groundwater in the Sparta is at an elevation of +100 ft relative to NGVD.

Snider et al. (Reference 10) report that in general, water levels of the different sand units within the Sparta aquifer are within a few feet of one another at different locations due to the interconnected sands. However, local sand units may be disconnected.

Under natural flow conditions, the direction of groundwater flow in the Sparta aquifer in northern Louisiana is easterly from the outcrop areas in northwestern Louisiana to discharge areas in the Mississippi Valley (Reference 13). However, the intensive use of groundwater from the Sparta aquifer has resulted in a lowering of the potentiometric surface and modification of the flow pattern. Currently, the direction of groundwater flow in the Sparta Sand in northern Louisiana is generally to the east, with some local perturbations towards cones of depression created by pumping centers. The major cones of depression are centered at El Dorado, Arkansas, and Monroe, Louisiana (Reference 13). Snider et al. (Reference 10) report that pumping groundwater from the Sparta Sand has lowered the potentiometric surface in the Sparta extensively. For example, the potentiometric surface in the Sparta aquifer has declined 178 ft in 42 years at Junction City, Louisiana and the water level in the Sparta Sand at Ruston, Louisiana has declined 175 ft since 1920 (Reference 16). Ryals (Reference 14) reported that monitoring shows the regional water level decline in the Sparta aquifer in northern Louisiana ranges from less than 1 ft to about 3 ft/year depending on the well location relative to pumping centers. The potentiometric surface of the Sparta aquifer in northern Louisiana and southern Arkansas in the spring of 1980 is presented in Figure 2.5-12. This figure shows the effect of the large pumping centers on the direction of groundwater flow and also indicates that the elevation of the potentiometric surface in the vicinity of the CEC site in the spring of 1980 was approximately 80 ft relative to NGVD. In contrast, Payne (Reference 15) indicates that the potentiometric surface in the Sparta Sand in the vicinity of the site was 100 ft with respect to mean sea level in 1968. These references indicate that in the vicinity of the CEC site there was a 20 ft decline in the potentiometric surface from 1968 to 1980.

Table 9 summarizes values for hydraulic conductivity and transmissivity of the Sparta Sand aquifer. As indicated in Table 8, Snider et al. (Reference 10) report the hydraulic conductivity of the Sparta Sand in Union Parish to range from 200 to 780 gpd/ft^2 (27 to 105 ft/day) and average 400 gpd/ft^2 (50 ft/day). It is reported that these estimates may be higher than average because the locations where these hydraulic conductivity values were measured were selected as sources of wells yielding 200 gpm or more and may have had thicker coarse grained sands than average. Additionally, Payne (Reference 15) reports that in some areas the permeability of the same sand bed may vary 200 to 300 gpd/ft^2 within 1 mile. Given the maximum sand unit thickness of 150 ft in the vicinity of the site, Payne (Reference 15) reports that the average coefficient of permeability (hydraulic conductivity) is 450 to 500 gpd/ft^2 (60 to 67 ft/day).

Snider et al. (Reference 10) report that in West Monroe, Louisiana, located approximately 47 mi southeast of the site, yields of wells in the Sparta aquifer are as high as 1,800 gpm, with specific capacities as high as 43 gpm/ft of drawdown. Transmissivities are reported to range from 7,000 to 83,000 gpd/ft (940 to 11,000 ft^2/day) and the coefficient of storage is on the order of 4×10^{-4}.

In a more recent study, in estimating transmissivity values for the Sparta Sand, Nelson and Hebert (Reference 17) used the geostatistical technique of kriging. Their study area extended over a 10,500 sq mi area of northern Louisiana and southern Arkansas. The CEC site is located in the west central portion of the study area. Although kriging errors were large due to the scarcity of data for the study area, the model was found to be generally insensitive to constant transmissivity values of 3,000, 5,000 and 10,000 ft^2/day (22,400, 37,300 and 74,600 gpd/ft). Kriged transmissivity values of 2,000 to 4,000 ft^2/day (15,000 to 29,800 gpd/ft) were used for the Sparta Sand in the vicinity of the CEC site.

In discussing the quality of ground water in Union Parish, Louisiana, Snider et al. (Reference 10) report that groundwater in the Sparta is a very soft, sodium bicarbonate type water with a pH range between 7.3 and 8.9. The water is generally of good quality and is satisfactory for most purposes without treatment. Differences in water quality are observed between shallower and deeper wells. Sands near the base of the Sparta contain ground water with a high chloride content and water from this depth is not used as a source of water. However, in another location, shallower wells yield water with a moderately high chloride content (320 to 400 mg/l). These sands do not appear to be widespread, as they pinch out into sands containing fresh ground water. The concentrations of chloride and bicarbonate generally increase towards the east across Union Parish, Louisiana. Snider et al. (Reference 10) reports that water in the upper 300 ft of the Sparta aquifer generally has a higher bicarbonate concentration than that in the lower part of the Sparta. The color of groundwater samples collected from the Sparta aquifer in Union Parish has ranged from not visible to about the color of tea. The average color is considered to be barely visible (about 40 NTU units).

All available chemical quality data from groundwater samples collected from the Sparta Sand aquifer in Claiborne Parish are summarized in Tables 2.5-10 and 2.5-11. In addition, water supply wells screened in the Sparta Sand aquifer were sampled as part of the CEC site investigation. This data is presented in Table 2.5-12. All of this data indicates that groundwater from the Sparta in Claiborne Parish is generally of as good or better quality than the quality of groundwater in Union Parish. Based on this finding, the groundwater for the CEC facility is of potable quality.

2.5.2.2.4 Cook Mountain Formation

The Cook Mountain Formation is predominantly composed of silty clay with thin sand and silt beds. Snider et al. (Reference 10) reports that in Union Parish, silty clay beds generally compose about 80% of the formation and the base of the Cook Mountain contains a 50 to 110 ft-thick massive silty clay bed. These sediments retard movement of groundwater between the sands in the Cook Mountain and the underlying Sparta Sand. The silty clay in the Cook Mountain may be gray, brown, green, or blue. The clay is either glauconnitic or lignitic. Additionally, thin layers of ferruginous siltstone and other lithified material may be present within the Cook Mountain. The sands are mostly green, with some being gray or dark gray. Sand beds are discontinuous and are generally less than 30 ft thick, although some may be as thick as 55 ft. The Cook Mountain also contains marine fossils. It is the fossils, green sands and glauconite that distinguish the Cook Mountain Formation from the underlying Sparta Sand and overlying Cockfield Formation, which contain more gray sands and lignite.

Ryals (Reference 9) illustrates that the Cook Mountain Formation crops out over most of Claiborne Parish and may be up to 150 to 200 ft thick. Law Engineering (Reference 18) reports that the Cook Mountain Formation can be up to 300 ft thick. The elevation of the base of the Cook Mountain in the vicinity of the site is close to 0 ft NGVD. In application of a steady state groundwater flow model to predict the piezometric surface of the Sparta Sand aquifer in northern Louisiana, Nelson and Hebert (Reference 17) assigned a hydraulic conductivity value of 2 x 10^{-5} ft/day to the Cook Mountain Formation. It was determined that the potentiometric surface of the Sparta Sand is very dependent upon leakage through the Cook Mountain Formation. Snider et al. (Reference 10) report that some of the sand units in the Cook Mountain Formation are capable of supplying enough groundwater for domestic wells (approximately 10 gpm). However, these sand beds are generally siltier and less permeable than sands in the underlying Sparta Sand.

Groundwater from the Cook Mountain Formation in Union Parish is of the sodium bicarbonate type, with a maximum dissolved solids content of 428 mg/l. The chloride content was reported to be lower than the Sparta, and groundwater from the Cook Mountain Formation was found to be soft and low in iron, fluoride and color (Reference 10).

2.5.2.2.5 Cockfield Formation

The Cockfield Formation is divided into a marine and non-marine unit and is mostly comprised of gray sand, silty clay and lignite. The sand beds are fine to medium grained and may be up to 95 ft thick. These sands contain thin lignite beds. Because these sands are thicker and more continuous than sands in the Cook Mountain Formation, groundwater from the Cockfield Formation is used as a rural water supply.

Ryals (Reference 9) illustrates that where present, the Cockfield Formation ranges in thickness from 0 to 200 ft and that a surface contact occurs between the Cook Mountain Formation and the Cockfield Formation in the vicinity of the site. Law Engineering (Reference 18 and 19) report that the Cockfield Formation is present on the CEC site at elevations above 310 ft. In the northern area of the site, the non-marine unit of the Cockfield is reported to be exposed at higher elevations. This non-marine unit primarily consists of light brown fine-grained sands with some silts and clays. The marine unit consisting of layers of siderite underlain by massive crossbedded sand and glauconitic sands is present beneath the non-marine unit. A perched water table may be present in places over the siderite.

Snider et al. (Reference 10) report that groundwater in the Cockfield Formation in Union Parish is recharged mostly by rainfall, and that some leakage may occur from the Cockfield into the underlying Cook Mountain Formation. Groundwater from the Cockfield Formation is reported to be soft, with a low dissolved-solids content, slight color and low pH (Reference 10).

2.5.2.2.6 Upland Terrace Deposits

The upland terrace deposits crop out in the eastern part of Union Parish and consist of silty clay, sand and gravel. In this area of northern Louisiana, these deposits may be up to 70 ft thick. Snider et al. (Reference 10) report that groundwater is most likely present in the upland terrace deposits under water table conditions. Groundwater wells in these deposits are reported to yield sufficient supplies of satisfactory quality for domestic and livestock uses. The movement of groundwater in the upland terrace deposits is reported to be lateral to the Ouachita River in Union Parish and downwards into the underlying Tertiary formations. These terrace deposits are not present at the site.

2.5.2.2.7 Alluvium

Snider et al. (Reference 10) report that in Union Parish alluvium underlies the valleys of the Ouachita River and its larger tributaries. Alluvial sediments generally consist of unconsolidated clay, silt, sand and gravel. In Union Parish there are few wells in the alluvium because of flooding in the valleys containing alluvium. Groundwater levels in alluvial wells will fluctuate with the stages of the river. The quality of the groundwater in the alluvium may vary; in some areas it may be contaminated by human activities. In general, iron removal and softening treatment may be necessary prior to public supply use.

2.5.2.3 Site Hydrogeology

2.5.2.3.1 Shallow Groundwater Beneath the Site

During the last week of July 1990, seven shallow groundwater wells were installed on the CEC site. Subsequent monitoring of the site wells was undertaken in early August 1990. Locations of the shallow wells are presented in Figure 2.5-13. The monitoring consisted of the collection of undisturbed aquifer material through the use of Shelby tubes during drilling and groundwater samples and slug tests of each well. The Shelby tube samples were analyzed for density, porosity, specific gravity, moisture content and total organic carbon, while the groundwater samples were analyzed for physical parameters (such as total suspended solids) and inorganic chemicals. Shallow groundwater wells were screened in the first encountered saturated zone. Descriptions of the screened units and measured aquifer parameters are presented in Table 2.5-13.

Based on the one observation period available, the elevation of shallow groundwater beneath the CEC site generally mirrors the topography and follows the surface water drainage basins. This is illustrated in Figure 2.5-14 which shows the site surface topography and contours of the shallow groundwater. Due to the topographic high located in the central portion of the CEC site, surface water drainage extends radially with dominant flow to the northeast northwest and southwest. A three-dimensional view of the shallow groundwater contours from the northwest to the southeast is presented in Figure 2.5-15. This figure indicates there is a much steeper slope of the water table towards Bluegill Pond than towards Lake Avalyn.

The geology of the uppermost strata underlying the property was found to be highly variable consisting of intermittent and discontinuous units of sands, silty sands and clays. Based on 40 borings in the central portion of the property, Law Engineering (Reference 19) found numerous discontinuous sedimentary units across distances as short as 200 ft. Due to the discontinuous nature of the site geology, the interconnections between water-bearing units in these different basins (and hence the groundwater flow patterns) are variable. For example, one area of seeping groundwater was identified in the northwestern drainage area southwest of the D-1 well. The discharge of groundwater to the surface in this area is an indication of a poor interconnection between water-bearing units. Conversely, the lack of seeps in the southwestern and northeastern drainage basins indicates that a stronger interconnection exists between those discontinuous water-bearing units situated at topographic highs and the water-bearing units in the lower topographic areas of these basins. In addition, data from the well nest installed in the northeastern basin adjacent to Lake Avalyn (Wells B-1 and B-2) revealed potentiometric head levels in the shallow well to be 65 ft above those in the deep well. This dictates that any vertical flow of groundwater in this area would be downward. However, the extent of this flow as well as flow between individual stratigraphic units in the other basins is somewhat uncertain.

As is the case with the interconnection between the subsurface water-bearing units, the interaction between groundwater and surface water appears to vary across the different basins. In early August 1990, water levels in Lake Avalyn and Bluegill Pond were approximately 6 inches and 7 feet, respectively, above the shallow groundwater at these points. Based on this, any interaction between the surface water and the groundwater at these staff gauging locations would take the form of a downward component of flow. However, as discussed in Section 2.5.1.3, samples collected in May 1990 showed that the lake and pond sediment near the dams are highly cohesive hard clay, and it is likely that these clays are not very permeable. In addition, since no other water source exists, groundwater baseflow must provide water to all surface water bodies on the property in some areas or during some seasons. Therefore, it is expected that upward components of flow exist in other areas of these waterbodies most likely along the up-gradient reaches (southern section of Lake Avalyn and northern section of Bluegill Pond).

2.5.2.3.2 Off-Site Groundwater Flow

As discussed in Section 2.5.2.3.1, the flow of both surface water and groundwater on the CEC site generally follows the topography of the land. It is likely that this pattern continues in each of the basins off of the property. The drainage basins to the east and southwest of the CEC site (McCasland and Cypress Creeks, respectively) were observed during the last week in July 1990. While the upper reaches of McCasland Creek at approximately 1/4 mi downstream from Lake Avalyn contained very small amounts of flow, points 2 and 4 mi downstream from the lake consisted of intermittent pools of standing water separated by long sections of dry bed. Conversely, during the same time period Cypress Creek was found to contain flow at the property boundary as well as at points 1.5 and 2.5 miles downstream from Bluegill Pond. However, standing pools were seen at the two downstream locations on Cypress Creek one week later (early August 1990). Based on these observations, the surface water/groundwater interaction in the two basins appears to be similar in nature. However, groundwater seems to be more sustaining of surface water baseflow in the Cypress Creek basin than it is in the McCasland Creek basin. This could be attributable to the possibility that groundwater flow along the McCasland Creek basin occurs at a greater depth than in the Cypress Creek drainage basin.

2.5.2.3.3 On-Site Groundwater Flow Rates

Based on the results of the fieldwork performed during the end of July and beginning of August 1990, groundwater flow rates (average linear velocities) were calculated for the three on-site drainage basins (to the northeast, northwest, and southwest). The equation used was the following form of Darcy's Law:

$$\overline{V} = \frac{K}{N}\left(\frac{dh}{dl}\right) \qquad \text{(Eq. 2.5-A)}$$

where:

$\overline{V}$	=	average linear groundwater velocity (ft/day);
K	=	hydraulic conductivity (ft/day);
N	=	porosity (%);
dh/dl	=	hydraulic gradient (ft/ft).

Average linear velocity values were calculated for the northeast basin using wells A-1 and B-1; for the northwest basin using A-1 and D-1; and for the southwest basin using A-1 and C-1, E-1 and C-1, and F-1 and C-1. Parameters for these wells are presented in Table 2.5-14.

Hydraulic conductivity values were calculated from data collected during the on-site slug tests in combination with Shelby tube analyses.

Prior to being used for the calculation of flow rates, hydraulic conductivity and porosity values were compared to ranges presented in the literature (Reference 20 and 21). These parameters were found to be within normal ranges for the types of geologic materials screened.

For the estimation of a flow rate between two wells (for example, A-1 and B-1), average hydraulic conductivity and porosity values were calculated. These values, along with the hydraulic gradient between the wells, were used to calculate the average linear velocities presented in Figure 2.5-16.

It should be noted that these calculations assume a hydraulic interaction between the screened units at the different wells. Although this is likely to be the case, it is possible that a stronger interconnection exists with a unit not screened. For example, the average linear velocity between Wells A-1 and C-1 was estimated to be 3.4 ft/year. While this velocity may be accurate, it is possible that groundwater preferentially flows from Well A-1 to the southwest through a different unit than is screened at Well C-1, and it may discharge in the form of a spring prior to reaching C-1. In some areas, this preferential flow could be at a rate which is significantly larger than 3.4 ft/year.

2.5.2.3.4 Chemistry of Shallow Groundwater

Chemical data from water samples collected from the on-site groundwater monitoring wells are presented in Table 2.5-15 (unfiltered samples) and Table 2.5-16 (filtered samples). This data indicates the shallow groundwater is generally of good quality. Most of the metals detected in the unfiltered samples are associated with suspended solids because, with the exception of zinc, cadmium and copper, the metals were not detected in the filtered samples. Zinc, cadmium and copper are present in the filtered groundwater samples at low concentrations.

2.5.2.4 <u>Groundwater Use in the Vicinity</u>

Groundwater is the source of public water supply for all of Claiborne Parish. Approximately 21,700 people are served by 12 water systems. The 12 systems and the number of people they serve are presented in Table 2.5-17. All of the water supply systems in Claiborne Parish are reported to obtain water from the Sparta Aquifer.

In a study of water requirements and availability for Louisiana, Urban Systems (Reference 22) reported that groundwater in Claiborne Parish is used for industrial and rural domestic supply and livestock watering. The groundwater source for Claiborne

Parish is reported to be primarily from the Sparta Sand aquifer. Total water use projections in Claiborne Parish for 1990 are 1.39 million gallons per day (mgd). Water use projections increase only slightly over the next 30 years to 1.44 mgd by 2020.

Groundwater also serves as the water supply for households not connected to public water systems. However, wells drilled for domestic supply have primarily been found to be shallow (i.e., 18 to 72 ft) and produce water from small intermittent sand units and lenses which are a part of the Cockfield Formation. Three existing shallow on-site wells were identified during the site investigation. Two of these wells are located in the vicinity of Lake Avalyn and the third is centrally located on the property. It is believed that these wells were formerly used for domestic purposes. In addition, a door-to-door water use survey was conducted within a 2-mile radius of the CEC site. During the survey, 40 of the 51 individuals contacted responded with water use information. Of those that responded, 13 residences have shallow wells (11 residences have wells that are currently being used). Four of the active wells are located within 1/2 mi of the property boundary to the northwest, one is 1/3 mi due north, six are 1 mi or greater to the southeast, and the remaining two are 1-1/4 mi and 2 mi due south. All of the 11 active wells identified are used for household (domestic) purposes. Ten of the wells are used also for gardening and/or livestock watering.

Information obtained from the water use survey and other sources indicates that the nearest neighboring well that withdraws groundwater from the Sparta Sand aquifer is the Central Claiborne Water System Well #4. An evaluation was conducted to estimate the potential effect that the withdrawal of groundwater from the Sparta Sand aquifer by the facility will have on the groundwater in the vicinity of Well #4. Additionally, this evaluation will predict any potential effects on groundwater in the Sparta beneath the CEC site caused by pumping groundwater from the Central Claiborne Water System Well #4.

The Theis equation (Reference 23) was used to evaluate the effects of water withdrawals from the Sparta Aquifer. Using known aquifer values for transmissivity and storativity and an assumed pumping rate, the Theis solution is used to predict drawdown in a confined aquifer at any distance from the pumping well for any time. It is believed that this application results in a conservative estimation (probable overestimation) of drawdown in groundwater levels associated with site pumping since recharge to the system is not considered. Consequently, recharge to the Sparta, which occurs in the form of leakage through the Cook Mountain Formation (Section 2.5.2.2.4), would result in actual declines which are less than the aquifer's predicted response. In addition, conservative modeling parameters were consistently selected increasing the likelihood that actual water level declines would be less than those predicted. It should be mentioned, however, that in addition to the drawdown predicted in the discussion below, a drawdown of 1 to 3 ft/year may be observed due to the regional water level decline caused by large pumping centers in northern Louisiana and southern Arkansas (Section 2.5.2.2.3).

The parameters used in the model are presented in Table 2.5-18. The two transmissivity values of 15,000 and 75,000 gallons per day/ft (gpd/ft) were obtained from tests performed on wells in the area which are screened in the Sparta; these values represent the low and mid range found in the records (see Table 2.5-9 and Section 2.5.2.2.3). As lower transmissivities result in greater water level decline estimates, the value of 15,000 gpd/ft is used in the conservative case. The storativity value of 1×10^{-4} (dimensionless) was obtained from the literature (Reference 21) and is based on an assumed aquifer thickness of 100 ft. As reflected in Table 2.5-8, 100 ft is the low end of the range of thicknesses of sand units in the Sparta aquifer in the vicinity of the CEC site. Greater thicknesses (and hence higher storativity values) would result in lesser declines in water levels.

To evaluate groundwater withdrawal, a range of pumping rates at the CEC was considered. It is unlikely that any of these withdrawal rates will be continuous, rather pumps are likely to be turned on when needed to fill water supply storage tanks. The use of continuous pumping in the evaluation adds another measure of conservatism since some degree of recovery is likely during the periods when pumping is not occurring. For the CEC site wells, combined total pumping rates of 5, 15, and 50 gallons per minute (gpm) were analyzed. Five and 15 gpm are the expected average and maximum normal required pumping rates. Each of the two wells is equipped with a 50 gpm pump and only one pump will be operated during normal facility operations. However, during an emergency situation both pumps could be operated simultaneously for a short period of time. Because the two facility wells are close to one another (550 ft) compared to the overall distance between these wells and the Central Claiborne Water Supply System Well #4 (2.5 mi), groundwater withdrawal was modeled from one point centrally located within the facility. The effects of the pumping rates were evaluated for a 30-year time period which is the projected operational life of the facility. Although the 50 gpm scenario was analyzed for the full 30-year duration, pumping at this rate would most likely occur only for very short times periods, if at all. As previously mentioned, drawdown in the Sparta as a result of withdrawal by the Central Claiborne Water Supply System Well #4 was also evaluated. While the current pumping rate from this well is 2 million gallons per month (46 gpm average), the 55 gpm pumping rate which was used in the evaluation reflects an upward adjustment to compensate for expected population growth in the region (Section 2.2.1).

The results of the evaluation are presented in Table 2.5-19 for the two different aquifer transmissivity values and the three different pumping rates from the LES Well. Drawdown under these conditions is estimated at the southern edge of the CEC site boundary (0.5 mi from the LES Well), at a point between the two wells (1.5 mi from the LES Well), and at Well #4 (2.5 mi from the LES Well). As can be seen from Table 2.5-19, most of the projected declines in potentiometric levels attributable to the LES Well are less than 1 ft and only in the cases of the higher pumping rates and the lower transmissivity value do the declines exceed 1 ft. If groundwater is pumped from the Sparta Sand aquifer by the LES Well at a rate of 5 gpm, less than 3% of the total drawdown observed at well #4 will be due to pumping at the CEC site. Under the maximum evaluated pumping rate of 50 gpm by the LES Well, less than 1/4 of the total observed drawdown at well #4 would be caused by pumping at the CEC site. This evaluation also shows that for pumping rates of 5 or 15 gpm at the CEC site, the majority of the drawdown observed at the southern boundary of the CEC site is due to pumping by Well #4. If the CEC facility was to pump groundwater continuously at a rate of 50 gpm, as much as 55% (or 4.3 ft) of the total drawdown observed at the southern boundary of the CEC site and 23% of the total drawdown observed at Well #4 could be due to the LES facility. Since the assumptions made in this evaluation are conservative, actual water level declines in the Sparta Sand aquifer as a result of withdrawal by these pumping centers are expected to be less than the predicted values. However, additional observed declines in the potentiometric head due to large regional pumping centers may be as great as 10 to 30 ft over the 30-year period of operation of the facility. This regional decline should not adversely impact the ability of the aquifer to supply the relatively small volumes of water withdrawn by the facility or Well #4, nor will the CEC impact the ability of current users of the aquifer to withdraw water.

2.5.2.5 Potential Sources of Groundwater Contamination

In order to identify potential sources of groundwater contamination in the vicinity of the CEC, the following agencies were contacted:

- The Louisiana Department of Environmental Quality (Groundwater Protection and Water Pollution Control Divisions)
- The U.S. Geological Survey (GWSI Database)
- The Louisiana Department of Health and Hospitals
- The Claiborne Parish Public Health Department
- Louisiana Department of Transportation

Potential sources of groundwater contamination on or near the CEC site are limited to the gas well discussed in Section 2.5.1.5. Additionally, although they have not been located, there may be old septic tanks on or in the vicinity of the site. Two groundwater samples (a sample and its duplicate) were collected from a shallow abandoned residential well located on the CEC site approximately 0.3 mi northeast of the gas well located near the southwest corner of the site property. No detection limits in the priority pollutant scan were exceeded in either sample. It should be noted that the fate and transport of contaminants in shallow groundwater in the vicinity of the site would be highly variable due to the complex interlayering units of sand, silt and clay.

2.5.2.6 Potential Effects of Deforestation on Site Hydrogeology

Research shows that deforestation can impact shallow groundwater. Although their study is not directly applicable to the site precipitation patterns, Ryckborst (Reference 24) tracked changes in the water table observed during snow melt, following timbering of an area. A slight increase in effective porosity in the groundwater recharge areas was observed, resulting in drop of 0.2 to 0.5 m in the elevation of the water table in recharge areas. However, in groundwater discharge areas there was a rise in the water table. Overall Ryckborst (Reference 24) reported that these changes were minor and temporary.

Other observations on the effect of timbering on groundwater show that increases and decreases in soil moisture may result. Patric (Reference 4) states that rainfall infiltrates more readily into moist soil. McClurkin and Moehring (Reference 5) report that more water is available for recharge because evapotranspiration decreases following deforestation. However, logging activities compact the soil and destroy the soil structure, decreasing soil water due to restricted infiltration and an increase in surface runoff. Additionally, overland flow may result in saturated areas which can initiate sheet and rill erosion. Overall, the effect is dependent on the rate of regrowth of vegetation following timbering activities. Although large portions of the site had been timbered by the previous landowner, regrowth has been rapid, with only a few disturbed staging areas remaining with little vegetation approximately 5 months after timbering began. Therefore, long term effects of the deforestation on the groundwater are not expected to be observed at the CEC site.

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Table 2.5-1

Low-Flow Frequency Statistics and Peak Discharges for Two Locations in the Vicinity of the CEC Property

Bayou D'Arbonne Near Dubach, Louisiana (a)

Average Monthly Discharge (ft^3/sec) for the Indicated Recurrence Interval (b)

Recurrence Internal	January	February	March	April	May	June	July	August	September	October	November	December
						1-Day						
Q2	126	252	253	162	63	13	2.9	1.1	1.4	0.8	3.1	40
Q10	16	56	72	58	9.5	0.9	0	0	0	0	0	0.8
Q20	7.8	32	44	40	5.2	0.4	0	0	0	0	0	0.2
						7-Day						
Q2	186	318	303	217	85	22	6	1.8	2.3	0.8	5.2	61
Q10	24	74	101	77	15	1.5	0.1	0	0	0	0	1.1
Q20	12	44	68	51	8.6	0.6	0	0	0	0	0	0.2

Peak Discharges (c)

Water Year	Discharge (ft^3/sec)	Water Year	Discharge (ft^3/sec)
1941	13,100	1951	2,900
1942	7,760	1952	4,970
1943	3,210	1953	9,410
1944	15,400	1954	3,520
1945	23,400	1955	5,660
1946	10,200	1956	7,800
1947	8,610	1957	10,200
1948	6,040	1958	13,400
1949	2,400	1959	26,400
1950	8,570	1960	2,300

Table 2.5-1 (continued)

Low-Flow Frequency Stati[illegible] and Peak Discharges for Two Locations
in the V[illegible] of the CEC Property

Middle Fork Bayou D'Arbonne Near Bernice, Louisiana (d)

Average Monthly Discharge (ft^3/sec) for the Indicated Recurrence Interval (b)

Recurrence Interval	January	February	March	April	May	June	July	August	September	October	November	December
1-Day												
Q2	60	154	144	88	29	3.2	0.5	0	0	0	0	18
Q10	8.4	47	55	46	5.7	0.1	0	0	0	0	0	0.5
Q20	4.4	31	39	38	3.4	0	0	0	0	0	0	0.1
7-Day												
Q2	99	192	187	120	44	5.4	1.1	0	0.1	0	1.6	29
Q10	16	72	70	65	7.9	0.4	0	0	0	0	0	1
Q20	8.7	55	49	54	4.6	0.1	0	0	0	0	0	0.1

Peak Discharges (c)

Water Year	Discharge (ft^3/sec)	Water Year	Discharge (ft^3/sec)
1941	5,180	1951	1,380
1942	3,330	1952	3,950
1943	1,120	1953	4,170
1944	6,400	1954	1,560
1945	10,500	1955	3,510
1946	5,390	1956	1,723
1947	3,530	1957	6,360
1948	3,640	1958	28,000
1949	1,440	1959	5,540
1950	5,400	1960	1,160

(a) Approximately 18 miles downstream from Lake Claiborne.
(b) (Reference 25)
(c) (Reference 26)
(d) Approximately 20 miles downstream from Lake Avalyn.

Table 2.5-2

Estimates of Surface Water Flow in Streams
On or In the Immediate Vicinity of the CEC Site

Location	Discharge (ft3/sec) January 1990	May 1990	July 1990
Lake Avalyn Drainage Basin			
Southern flow to Lake Avalyn	0.60	0.16	NE
Discharge from Lake Avalyn	2.40	1.65	0.07
Bluegill Pond Drainage Basin			
Total flow into Bluegill Pond	0.47	0.38	NE
Discharge from Bluegill Pond	0.67	0.50	NE
Flow in tributary from SW corner of LES property to LES property	1.40	0.57	NF
Flow at the SW property boundary after confluence of Bluegill Pond discharge with the tributary from the SW	1.90	NE	0.22
Northwest Drainage Basin			
Flow in tributary on NW corner of LES property	0.32	NE	NF

NE = Not estimated.
NF = No flow identified; standing water only.

Table 2.5-3

Hold-Up Basin Features

Basin

Drainage Area .... 83 acres
(plant yard - 65 acres, drainage area adjacent to plant yard - 18 acres)

Water Surface Elevation (normal pond) .... 300+0 msl

Surface Area .... 3 acres
(water surface @ elevation 300+0)

Storage Capacity .... 38 acre-feet
(water surface @ elevation 300+0, prior to sediment accumulation)

Projected Storage Capacity .... 27 acre-feet
(water surface @ elevation 300+0, after sediment accumulation)

Available Storage Volume .... 14 acre-feet
(storage between elevation 300+0 (normal pond) and elevation 304+0 (emergency spillway))

Estimated Average Annual Evaporation .... 12.5 acre-feet

Estimated Average Annual Inflow .... 307 acre feet
(based on average annual precipitation of 45 inches)

Routing Results, 25 Year Storm
Peak Stage .... 303+10 msl
Peak Discharge .... 168 cfs

Routing Results, SPF
Peak Stage .... 305+10
Peak Discharge .... 400 cfs

Dam

Compacted Earth Embankment, Homogeneous Material - Silty Clay (CL)

Designed for Normal and Seismic Loadings

Table 2.5-3 (continued)

Hold-Up Basin Features

Crest Elevation	307+0 msl
Embankment Slope (upstream and downstream faces)	2:1
Maximum Height	29 feet
Length of Crest	700 feet
Width of Crest	16 feet
Freeboard	
Normal Pond	7 feet
25 Year Storm	3.2 feet
SPF	1.2 feet
Slope Protection	Stone Rip-Rap

Table 2.5-4

Chemical Data for Samples Collected
From Lake Avalyn Drainage Basin
(mg/l)

Chemical Parameter	1 Inflow (b)		2a Lake Surface Water (b)		2b Lake Bottom Water (b)		3 Outflow	4 Outflow (Dwnstr)
Calcium	1.4	1.3	1.2	1.2	1.6	NA	1.6	1.8
Magnesium	0.76	0.69	0.55	0.56	0.57	NA	0.57	0.7
Potassium	1.2	1.4	1.0	1.0	1.7	NA	1.7	1.8
Sodium	2.6	2.3	1.4	1.4	1.4	NA	1.4	1.8
Hardness (c)	6.6	6.1	5.3	5.3	6.3	NA	6.3	7.4
Silver	<0.08	<0.08	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Beryllium	<0.002	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony	<0.8	<0.8	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Zinc	0.046	0.036	0.010	0.013	0.016	0.025	0.020	0.011
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	0.00064	0.00016	<0.0001	<0.0001
Thallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	<0.0020	<0.0020	<0.0020	<0.0020	<0.0010	0.0012	0.0012	0.0012
Selenium	<0.004	<0.004	<0.004	<0.004	<0.002	<0.002	<0.002	<0.002
Cadmium	0.00048	0.00041	0.00022	0.00025	0.00023	0.00028	0.00025	0.00038
Chromium	0.0030	0.0022	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010
Copper	0.0026	0.0026	0.0023	0.0020	0.0039	0.0038	0.0025	0.0018
Nickel	<0.0060	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Lead	0.0062	0.0036	<0.0020	<0.0020	0.0035	0.0038	0.0028	0.0026
Sulfate	11	11	8.8	7.7	NA	NA	8.3	9.1
Total suspended solids	10	12	<4.0	4.0	NA	NA	11	6.0
Total organic carbon	20	20	11	11	13	13	12	12
Nitrite & nitrate	<0.05	<0.05	<0.05	<0.05	NA	NA	<0.05	<0.05
Chloride	5.2	5.2	2.6	2.7	NA	NA	2.7	3.2
Ammonia nitrogen	<0.05	<0.05	<0.05	<0.05	NA	NA	<0.05	<0.07
Total phosphorous	0.024	0.024	0.021	0.021	0.032	0.035	0.026	0.030

(a) All samples collected in May 1990. See Figure 2.5-10 for sample locations.
(b) Duplicate sample results reported.
(c) $CaCO_3$ equivalent hardness.
NA = Not analyzed.

Table 2.5-5

Chemical Data for Samples Collected from

Bluegill Pond Drainage Basin (a)

(mg/l)

Chemical Parameter	5		6a		6b	7		8		9	10
	Inflow at the Eastern Point of the Pond (b)		Pond Surface Water (b)		Pond Bottom Water (c)	Outflow Around the Southern Side of the Pond (b,d)		Site Drainage Stream (b,e)		Outflow at Western Property Boundary (f)	Cypress Creek Approx 1.5 Miles Downstream from Bluegill Pond (f)
Calcium	1.2	1.2	1.4	1.4	1.8	1.4	1.4	1.8	1.8	1.6	2.2
Magnesium	0.88	0.89	0.90	0.90	0.62	0.90	0.89	1.0	0.98	0.81	1.2
Potassium	2.0	2.0	[illegible]	3.2	1.9	3.2	[illegible]	1.8	1.7	NA	NA
Sodium	2.6	2.7	2.0	1.9	1.4	1.9	1.9	4.2	4.4	2.8	2.1
Hardness (g)	6.6	6.7	7.2	7.2	7.0	7.2	7.2	8.6	8.5	7.3	10.4
Silver	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.040	<0.040
Beryllium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Zinc	0.029	0.021	0.007	0.023	0.020	0.023	0.017	0.010	0.008	0.005	0.009
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	[illegible]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Thallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA	NA
Arsenic	0.0013	0.0012	<0.0010	0.0013	0.0013	<0.0010	<0.0010	<0.0010	0.0013	<0.0010	0.0013
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.0020	<0.0020
Cadmium	0.00029	0.00033	0.00015	0.00017	0.00013	<.00010	0.00015	0.00026	0.00020	0.00023	0.00011
Chromium	0.0020	0.0021	0.0026	0.0021	<0.0010	0.0028	0.0021	<0.0010	0.0010	<0.0010	<0.0010
Copper	0.0018	0.0023	0.0026	0.0025	0.0045	0.0021	0.0020	0.0016	0.0016	0.0005	0.0001
Nickel	0.0048	0.0051	0.0039	0.0032	0.0036	0.0048	0.0042	0.0031	0.0033	<0.0038	0.0078
Lead	0.0024	<0.0020	0.0020	0.0027	<0.0020	0.0025	0.0025	0.0021	<0.0020	<0.0020	<0.0020
Sulfate	11	12	7.0	6.1	10	11	6.7	7.3	6.8	NA	NA
Total suspended solids	9.0	29	18	16	10	31	23	5.0	<4.0	9	10
Total organic carbon	6.4	6.2	12	12	14	12	12	4.3	4.3	4.4	6.5
Nitrite & nitrate	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.12
Chloride	3.6	3.6	3.5	3.5	3.1	3.7	3.6	9.2	9.0	5	3.8
Ammonia nitrogen	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.19	<0.05
Total phosphorous	0.019	0.018	0.030	0.030	0.041	0.033	0.034	0.020	0.016	0.022	0.039
Total alkalinity	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.4	8.3
Total solids	NA	NA	NA	NA	NA	NA	NA	NA	NA	73	72

(a) All samples collected in May 1990 unless otherwise indicated.
(b) Duplicate sample results reported.
(c) Duplicate sample results not included; high concentrations indicate the presence of sediment in sample.
(d) Prior to its confluence with the stream.
(e) Sample collected May 22, 1990.
(f) Sample collected August 1, 1990.
(g) CaCO3 equivalent hardness.
NA = Not analyzed.

See Figure 2.5-10 for sample locations.

Table 2.5-6

Physicochemical Parameters of Lake Avalyn and Bluegill Pond

Depth (feet)	Lake Avalyn (1/20/90)			Lake Avalyn (5/23/90)			Bluegill Pond (1/20/90)			Bluegill Pond (5/23/96)		
	Temperature (Celsius)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/l)	Temperature (Celsius)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/l)	Temperature (Celsius)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/l)	Temperature (Celsius)	Conductivity (umhos/cm)	Oxygen (mg/l)
0	11	19	9.2	35	15	6.5	10.5	28	10.0	22	33	4.8
1	12	19	9.2	25	25	6.35	11	28	9.6	21.5	33	4.6
2	12	19	9.1	25	26	6.1	11	28	9.6	21	36	4.5
3	12	19	9.0	24	26	5.65	10	28	9.4	20	40	0.7
4	12	19	8.9	24	27	4.4	8	28	9.2	20	40	0.6
5	12	19	8.6	24	29	1.6	7	28	8.6	19	45	0.5
6	11	19	8.5	23	30	0.6	7	28	8.6	17.5	51	0.5
7	10	19	8.4	22	30	0.5	7	28	8.8	17	60	0.45
8	10	20	8.4	21	31	0.5	7	28	9.0	15	68	0.4
9	9.5	20	8.5	20	33	0.4	7	28	9.0	15	71	0.4
10	9	20	8.5	19	40	0.4	6.5	28	8.8	14	76	0.4
11	9	20	8.4	18	43	0.4	6.5	28	8.8	13.5	88	0.35
12	9	20	7.5	18	47	0.4	6.5	28	7.6	13.5	94	0.3
13	9	20	6.9	17	48	0.3	--	--	--	--	--	--
14	9	20	6.1	17	52	0.3	--	--	--	--	--	--
15	--	--	--	17	55	0.3	--	--	--	--	--	--

	Lake Avalyn (1/20/90)	Lake Avalyn (5/23/90)	Bluegill Pond (1/20/90)	Bluegill Pond (5/23/96)
pH	5.31	6.21	NC: Meter malfunction	6.03
Turbidity	2.3 & 2.8 NTU	2.6 NTU	8.2 & 8.2 NTU	48 NTU
Alkalinity	2.0 & 3.0 mg/l ($CaCO_3$)	12 mg/l	4.0 & 4.0 mg/l ($CaCO_3$)	9.5 mg/l
Total hardness	8.4 & 7.6 mg/l ($CaCO_3$)	NC	7.4 & 7.4 mg/l ($CaCO_3$)	NC
Secchi disk depth	NC	43"	NC	11"

-- = Bottom of lake or pond.
NC = Data not collected.

Table 2.5-7

Hydrologic Units Identified in the Vicinity of the CEC Site

	Series	Group	Formation	Hydrologic unit
Quaternary	Holocene and Pleistocene		Terrace and alluvial deposits	Terrace and alluvial aquifers
Tertiary	Eocene	Claiborne	Cockfield Formation	Cockfield aquifer
			Cook Mountain Formation	Confining layer
			Sparta Sand	Sparta aquifer
			Cane River Formation	Confining layer
			Carrizo Sand	Wilcox-Carrizo aquifer
	Paleocene	Wilcox	Undivided	
		Midway	Undivided	Confining layer[1/]

[1/]Confining layer below Wilcox-Carrizo aquifer also includes units of Cretacepis age/
Source: Ryals, 1983, p. 4

Table 2.5-8

Elevation and Thickness of Sand Units Present in the Sparta Sand as Indicated in Logs from Wells in the Vicinity of the CEC Site (a)

Well CL-155 Drilled in 19[illegible]
Screened Interval 525 - 555
(feet below ground)

Depth to Sand Unit (feet below ground)	Elevation of Sand Unit (feet relative to MSL)	Thickness (feet)
465 - 494	-175 - -204	29
530 - 540	-240 - -250	10
600 - 660	-310 - -370	60

	Total:	99

Well CL-160 Drilled in 1982
Screened Interval 658 - 668
(feet below ground)

Depth to Sand Unit (feet below ground)	Elevation of Sand Unit (feet relative to MSL)	Thickness (feet)
298 - 333	-18 - -53	35
340 - 355	-60 - -75	15
466 - 480	-186 - -200	14
538 - 550	-258 - -270	12
582 - 678	-302 - -398	96

	Total:	172

Well CL-159 Drilled in 1982
Screened Interval 613 - 623
(feet below ground)

Depth to Sand Unit (feet below ground)	Elevation of Sand Unit (feet relative to MSL)	Thickness (feet)
256 - 324	39 - -29	68
333 - 355	-38 - -60	22
468 - 490	-173 - -195	22
510 - 522	-215 - -227	12
564 - 583	-269 - -288	19
594 - 645	-299 - -350	51
680 - 692	-385 - -397	12

	Total:	206

Well CL-129 Drilled in 1969
Screened Interval 514 - 526
(feet below ground)

Depth to Sand Unit (feet below ground)	Elevation of Sand Unit (feet relative to MSL)	Thickness (feet)
292 - 305	-12 - -25	13
311 - 326	-31 - -46	15
337 - 356	-57 - -76	19
404 - 437	-124 - -157	33
513 - 536	-233 - -256	23
542 - 552	-262 - -272	10
616 - 639	-336 - -359	23

	Total:	136

Well CL-173 Drilled in 1983
Screened Interval 690 - 710
(feet below ground)

Depth to Sand Unit (feet below ground)	Elevation of Sand Unit (feet relative to MSL)	Thickness (feet)
315 - 325	-35 - -45	10
336 - 350	-56 - -70	14
380 - 400	-106 - -125	20
430 - 440	-150 - -160	10
635 - 735	-355 - -455	100

	Total:	154

Well CL-163B Drilled in 1983
Screened Interval 688 - 708
(feet below ground)

Depth to Sand Unit (feet below ground)	Elevation of Sand Unit (feet relative to MSL)	Thickness (feet)
320 - 353	-20 - -53	33
362 - 383	-62 - -83	21
394 - 425	-94 - -125	31
540 - 666	-240 - -366	126
673 - 708	-373 - -408	35
714 - 740	-414 - -440	26

	Total:	272

Table 2.5-8 (continued)

Elevation and Thickness of Sand Units Present in the Sparta Sand as Indicated in Logs from Wells in the Vicinity of the CEC Site (a)

Well CL-140B Drilled in 1976
Screened Interval 635 - 655
(feet below ground)

Depth to Sand Unit (feet below ground)	Elevation of Sand Unit (feet relative to MSL)	Thickness (feet)
270 - 364	-70 - -164	94
400 - 432	-200 - -232	32
445 - 455	-245 - -255	10
475 - 536	-275 - -336	61
562 - 668	-362 - -468	106
	Total:	303

(a) Sand units less than 10 ft thick are not included. Wells are located on Figure 2.5-11.

Table 2.5-9

Hydraulic Parameters of the Sparta Aquifer as Reported by Various Sources

Hydraulic Conductivity

Value gpd/ft2	Value ft/day	Source	Area Considered
Range: 200-780 Average: 400	Range 27-105 Average: 50	Snider et al. (1972)	Union Parish
220 - >750	30 - >100	Ryals (1982a)	Vicinity of site
450 - 500	60 - 67	Payne (1968)	Vicinity of site
350 - 780	47 - 105	Well Logs	Within 4.5 mi of site

Transmissivity

Value gpd/ft	Value ft2/day	Source	Area Considered
7,000 - 83,000	940 - 11,000	Snider et al. (1972)	West Monroe
100,000 - 150,000	13,000 - 20,000	Payne (1968)	Vicinity of site
15,000 - 29,800	2,000 - 4,000	Nelson & Herbert (1986)	Vicinity of site
41,000 - 45,000	5,500 - 6,030	Well Logs	Within 4.5 of site

Table 2.5-10

Water Quality in the Sparta Aquifer from Wells in Claiborne Parish, Louisiana

(all values in mg/l unless stated)

Groundwater in the Arcadia-Minden Area (a)

Parameter	WELL: DEPTH: SAMPLE DATE:	CL-120 610 ft 7/17/68	CL-121 530 ft 7/17/68	CL-130 329 ft 8/6/70	CL-136 835 ft 5/29/74	CL-138 662 ft 3/14/75	CL-142A 461 ft 7/16/76	CL-142B 593 ft 7/12/76	CL-142C 702 ft 7/1/76	CL-145 610 ft 10/20/76
Specific conductance (umhos)		496	531	385	371	372	227	172	227	213
pH (units)		7.7	7.8	8.1	8	8.2	8.5	6.7	7.8	6.9
Temperature (celsius)		22	22	--	--	--	--	--	--	23.5
Color (platinum-cobalt units)		5	10	5	120	30	25	5	10	0
Hardness (as CaCO3)		6	8	15	4	7	10	5	8	19
Hardness, noncarbonate (CaCO3)		--	--	--	--	--	--	--	--	--
Calcium, dissolved		2.0	3.0	3.0	1.1	1.8	2.2	1.8	2.5	6.1
Magnesium, dissolved		0.2	0.1	1.8	0.3	0.6	1.0	0.1	0.4	0.9
Sodium, dissolved		110	130	86	81	85	49	36	49	38
Potassium, dissolved		1.3	1.2	3.1	1.4	1.1	1.2	1.4	1.0	3.5
Bicarbonate (as HCO3)		230	242	201	173	183	112	75	110	102
Carbonate		0	0	0	0	0	0	0	0	0
Sulfate, dissolved		45	71	29	25	19	15	16	15	20
Chloride, dissolved		13	14	5	11	11	4.2	4.5	3.7	3.1
Fluoride, dissolved		0.2	0.2	0.1	0.3	0.1	0.3	0.2	0.3	0.2
Silica, dissolved		8.0	12	14	14	11	19	50	33	35
Solids, dissolved		296	350	242	220	220	147	147	159	157
Nitrate, total		--	--	1.0	0.51	0.30	0.17	0	0	0.21
Nitrate, dissolved		0.1	0.1	--	--	--	--	--	--	--
Iron, dissolved		1.1	0.07	0.03	0.27	0.23	0.06	0.07	0.05	0.45
Manganese, dissolved		--	--	0	0	0	0	0	0	0.06
Alkalinity (as CaCO3)		--	--	--	--	--	--	--	--	--
Aluminum,dissolved		--	--	--	--	--	--	--	--	--
Antimony, dissolved		--	--	--	--	--	--	--	--	--
Arsenic, dissolved		--	--	--	--	--	--	--	--	--
Barium, dissolved		--	--	--	--	--	--	--	--	--
Beryllium, dissolved		--	--	--	--	--	--	--	--	--
Cadmium, dissolved		--	--	--	--	--	--	--	--	--
Chromium, dissolved		--	--	--	--	--	--	--	--	--
Cobalt, dissolved		--	--	--	--	--	--	--	--	--
Copper, dissolved		--	--	--	--	--	--	--	--	--
Lead, dissolved		--	--	--	--	--	--	--	--	--
Lithium, dissolved		--	--	--	--	--	--	--	--	--
Mercury, dissolved		--	--	--	--	--	--	--	--	--
Molybdenum, dissolved		--	--	--	--	--	--	--	--	--
Nickel, dissolved		--	--	--	--	--	--	--	--	--
Selenium, dissolved		--	--	--	--	--	--	--	--	--
Silver, dissolved		--	--	--	--	--	--	--	--	--
Zinc, dissolved		--	--	--	--	--	--	--	--	--

(a) = (Reference 27)

Table 2.5-10 (Continued)
Water Quality in the Sparta Aquifer from Wells in Claiborne Parish, Louisiana
(all values in mg/l unless stated)

	USGS Water Resources Data Louisiana											
	1982 Report (b)		1984 Report (c,d)		Cooperative Program with Louisiana Department of Transportation (d)							
Well:	CL-159	CL-160	CL-163A	CL-163B	CL-14	CL-122B	CL-123	CL-126	CL-129	CL-140A	CL-140B	
Depth:	623 ft	668 ft	Not Available									
Parameter / Sample Date:	3/11/82	3/22/82	1/11/84	12/20/83	03/05/42	10/24/67	07/23/68	08/14/68	01/28/69	02/10/76	01/29/76	AVERAGE (e)	MAXIMUM
Specific conductance (umhos)	271	272	192	203	--	218	208	116	284	190	200	270.9	531
pH (units)	8	7.2	6.9	6.8	--	7.1	7.5	7.3	8.2	7.2	6.8	7.5	8.5
Temperature (celsius)	24.5	24	24	24	--	21.5	23	20	23	22	23	22.8	24.5
Color (platinum-cobalt units)	20	5	20	5	--	5	10	5	60	15	20	19.7	120
Hardness (as CaCO3)	1	2	19	6	42	55	2	32	4	32	7	14.2	55
Hardness, noncarbonate (CaCO3)	1	2	19	6	--	55	2	32	4	32	7	16.0	55
Calcium, dissolved	0.2	0.1	6.6	1.6	--	17	0.6	8.3	1	9.1	2.6	3.7	17
Magnesium, dissolved	0.1	0.4	0.6	0.6	--	3.1	0.1	2.7	0.4	2.2	0.1	0.8	3.1
Sodium, dissolved	68	64	32	31	--	24	50	9.3	70	28	42	57.0	130
Potassium, dissolved	0.7	1.1	2.5	1.5	--	2.6	0.9	2	0.6	2.9	1.3	1.6	3.5
Bicarbonate (as HCO3)	--	--	--	--	1	120	120	57	170	89	100	130.3	242
Carbonate	--	--	--	--	--	0	0	0	0	0	0	NA	NA
Sulfate, dissolved	17	21	16	13	17	0.2	6.6	3	0.2	9.8	<1.0	18.9	71
Chloride, dissolved	5.1	4.9	6	9.2	18	5.5	5	4.9	7.6	9.9	10	7.8	18
Fluoride, dissolved	0.3	0.3	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3
Silica, dissolved	15	27	51	39	--	18	43	45	9.8	30	53	27.7	53
Solids, dissolved	183	183	158	152	--	132	163	106	175	137	161	183.6	350
Nitrate, total	0.64	0.72	0.09	0.33	--	--	--	--	0.8	0.1	0.08	0.4	1
Nitrate, dissolved	--	--	--	--	12	0.1	0	0	--	--	--	2.1	12
Iron, dissolved	0.04	0.16	1.3	1	--	0.83	0.05	2.2	0.37	1.6	1.4	0.6	2.2
Manganese, dissolved	0	0	0.05	0.029	--	--	--	--	0	0.065	0.037	0.017	0.065
Alkalinity (as CaCO3)	127	107	70	75	1	--	95	47	141	73	84	82.0	141
Aluminum,dissolved	--	--	<0.01	0.02	--	--	--	--	--	--	--	NA	0.02
Antimony, dissolved	--	--	<0.001	<0.001	--	--	--	--	--	--	--	NA	NA
Arsenic, dissolved	--	--	<0.001	0.001	--	--	--	--	--	--	--	NA	0.001
Barium, dissolved	--	--	0.051	0.042	--	--	--	--	--	--	--	0.047	0.051
Beryllium, dissolved	--	--	<0.0005	<0.0005	--	--	--	--	--	--	--	NA	NA
Cadmium, dissolved	--	--	0.001	<0.001	--	--	--	--	--	--	--	NA	0.001
Chromium, dissolved	--	--	<0.01	<0.01	--	--	--	--	--	--	--	NA	NA
Cobalt, dissolved	--	--	0.008	0.005	--	--	--	--	--	--	--	0.007	0.008
Copper, dissolved	--	--	<0.001	0.001	--	--	--	--	--	--	--	NA	0.001
Lead, dissolved	--	--	0.002	0.003	--	--	--	--	--	--	--	0.0025	0.003
Lithium, dissolved	--	--	0.011	<0.004	--	--	--	--	--	--	--	NA	0.011
Mercury, dissolved	--	--	<0.0001	<0.0001	--	--	--	--	--	--	--	NA	NA
Molybdenum, dissolved	--	--	<0.001	<0.001	--	--	--	--	--	--	--	NA	NA
Nickel, dissolved	--	--	0.004	0.001	--	--	--	--	--	--	--	0.0025	0.004
Selenium, dissolved	--	--	<0.001	<0.001	--	--	--	--	--	--	--	NA	NA
Silver, dissolved	--	--	<0.001	<0.001	--	--	--	--	--	--	--	NA	NA
Zinc, dissolved	--	--	0.21	0.21	--	--	--	--	--	--	--	0.21	0.21

(b) = (Reference 28)
(c) = (Reference 29)
(d) = (Reference 30)

(e) = Averages were calculated using only detected values.
-- = Not analyzed for in this sample.
NA = Not applicable; no detected values or only 1 detected value so an average could not be calculated.

Table 2.5-11

Water Quality from Public Supply Wells in Claiborne Parish, Louisiana
(all values in mg/l unless stated)

	Central Claiborne Water System							South Claiborne Water System		Athens Water Supply		Haynesville Water Supply		Homer Water Supply	
Sample Location:	Tap on Well #1	Tap on Well #2	Oilfield Road Well Site	Old Carpenter Well Out-Side Plant	New Carp. Well in Plant Area	New Well Carpenter's Site	New Well at Carp-enter's Site	Tap At Well #1	Tap at Well	Tap at Well #2	Tap at Well	Well at Blue Tower	Tap at Well at Blue Tower	May-Field Well	Tap at May-Field Well
Sample Date:	3/11/82	3/11/82	7/18/83	7/18/83	7/18/83	1/26/84	3/5/84	1/27/85	3/5/84	1/27/84	3/5/84	1/26/84	3/7/84	1/26/84	3/5/84
Parameter															
Color (platinum color units)	25	65		99	55	10	--	10	--	10	--	5	--	15	--
Turbidity	2.7	4.2		0.55	0.68	0.72	--	0.4	--	0.58	--	0.63	--	0.89	--
Total Dissolved Solids	235	315	[illegible]	305	307	198	--	171	--	347	--	135	--	123	--
Loss on Ignition	117	78	65	69	41	18	--	36	--	29	--	31	--	27	--
pH (units)	6.86	8.24	7.39	8.68	8.69	7.85	--	7.32	--	8.63	--	8.2	--	6.5	--
Temperature (celsius)	24	24	25	25	25	26	--	26	--	26	--	26	--	26	--
Free Carbon Dioxide	7.8	0	5.7	0	0	2.5	--	3.3	--	0	--	0	--	5.7	--
Total Alkalinity	109.3	259.7	95.9	236.5	242.9	111.7	--	52.1	--	180	--	91.1	--	54.2	--
Carbonate Alkalinity	0	24.3	0	27.2	40.8	0	--	0	--	41.4	--	7.8	--	0	--
Bicarbonate alkalinity	109.3	235.4	95.9	209.3	202.1	111.7	--	52.1	--	138.6	--	83.3	--	54.2	--
Total Hardness	4.3	5.4	2.3	2.3	4.5	6.6	--	12	--	8.7	--	13.1	--	18.6	--
Calcium Hardness	2.1	4.3	1.1	2.3	2.3	5.5	--	7.6	--	5.5	--	6.6	--	9.8	--
Magnesium Hardness	2.2	1.1	1.2	0	2.2	1.1	--	4.4	--	3.2	--	6.5	--	8.8	--
Chlorides	43.7	8.9	43.4	23.6	8.5	6.8	--	5.4	--	14.9	--	8.1	--	6.8	--
Iron	0.24	0.07	0.17	0.04	0.05	0.1	--	0.42	--	0.02	--	0.06	--	0.42	--
Manganese	0	0	0.01	0	0	0	--	0.02	--	0	--	0.01	--	0.01	--
Potassium	1.1	1.6	1.2	1.2	1.2	0.9	--	2.3	--	1.3	--	1.5	--	7.3	--
Sodium	69.5	121	70	117	119	57.7	--	35	--	117.5	--	36	--	18.5	--
Sulfate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	--	--	0	0	0	--	--	--	--	--	--	--	--	--	--
Selenium	--	--	0	0	0	--	--	--	--	--	--	--	--	--	--
Fluoride	0.3	0.3	0.3	0.3	0.3	--	0.1	--	0.1	0.2	0.2	0.1	0.1	0	0.1
Corrosivity Index (Langelier)	-2.55	-0.6	-2.05	-0.37	-0.36	-1.11	--	-1.83	--	-0.14	--	-0.76	--	-2.53	--
Gross Alpha (pCi/l)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gross Beta (pCi/l)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

(Reference 31)
-- = Not analyzed for in this sample.

Table 2.5-11 (continued)

Water Quality from Public Supply Wells in Claiborne Parish, Louisiana

(all values in mg/l unless stated)

	Lisbon Water Supply		Pinehill Water Supply		Wade Correctional Center		Norton Shop Water System				Summerfield Water System			
Sample Location:	Tap Off Pressure Tank Well Site	Tap Off Pressure Tank at Well	At Well	Tap at Well	Tap at Well	Tap at Well	Well at Tower Hwy 2 West	At Well	Tap on Well #1 Main Well	Tap on Well #2 Standby Well	Tap at Stand Pipe Well	Tap at Well at Stand-Pipe		
Parameter Sample Date:	1/30/84	3/5/84	1/26/84	3/7/84	1/30/84	3/7/84	1/26/84	3/7/84	5/10/85	6/13/85	1/27/84	3/7/84	Average (a)	Maximum
Color (platinum-cobalt units)	35	--	60	--	35.0	--	5	--	0	60	30	--	31	99
Turbidity	0.68	--	7.2	--	0.92	--	0.26	--	0.22	0.18	0.87	--	1	7
Total Dissolved Solids	222	--	162	--	177	--	139	--	126	122	204	--	207	347
Loss on Ignition	39	--	36	--	49	--	41	--	44	38	53	--	48	117
pH (units)	8.63	--	6.82	--	7.1	--	8.16	--	7.18	6.99	8.85	--	8	9
Temperature (celsius)	26	--	26	--	26	--	26	--	24	24	26	--	25	26
Free Carbon Dioxide	0	--	7.3	--	3.3	--	0.8	--	4.7	7.1	0	--	3	8
Total Alkalinity	147.5	--	65.1	--	70.5	--	88.9	--	86.9	73.8	273.3	--	132	273
Carbonate Alkalinity	31	--	0	--	0	--	0	--	0	0	62.1	--	14	62
Bicarbonate Alkalinity	116.5	--	65.1	--	70.5	--	88.9	--	86.9	73.8	211.2	--	118	235
Total Hardness	3.3	--	51.3	--	24	--	4.4	--	2.1	29.8	4.4	--	12	51
Calcium Hardness	2.2	--	31.6	--	13.1	--	3.3	--	2.1	19.1	2.2	--	7	32
Magnesium Hardness	1.1	--	19.7	--	10.9	--	1.1	--	0	10.7	2.2	--	4	20
Chlorides	9.5	--	8.8	--	10.1	--	9.5	--	9.6	9.6	13.5	--	14	44
Iron	0.03	--	--	--	1.16	--	0.02	--	0.04	1.72	0.03	--	0.29	2
Manganese	0	--	--	--	0.02	--	0	--	0	0.04	0	--	0.01	0
Potassium	0.7	--	3.8	--	2	--	0.7	--	0.7	2.8	0.7	--	1.53	4
Sodium	67.5	--	16.1	--	33	--	38.3	--	43	20.8	63	--	61.35	121
Sulfate	--	--	--	--	--	--	--	--	20	30	--	--	25	30
Arsenic	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA
Selenium	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA
Fluoride	--	0.2	--	0.1	--	0.1	--	0.1	0.1	0.1	--	0.2	0.17	0
Corrosivity Index (Langelier)	-0.59	--	-1.63	--	-1.71	--	-1.18	--	-2.31	-1.68	-0.11	--	-1.27	-2.55
Gross Alpha (pCi/l)	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA
Gross Beta (pCi/l)	--	--	--	--	--	--	--	--	--	--	--	--	NA	NA

(Reference 31)

(a) = Averages were calculated using only detected values.

NA = Not applicable; not enough detects to calculate an average or maximum.

-- = Not analyzed for in this sample.

Table 2.5-12

Chemical Data for Samples Collected from Two Wells in the Vicinity of the CEC Site (a)
(mg/l)

CHEMICAL PARAMETER	SAMPLING LOCATION: CENTRAL CLAIBORNE WATER SYSTEM WELL #4 (b)	SAMPLING LOCATION: LUDLOW CORPORATION WELL (c)	TRIP BLANK	FIELD BLANK
Total alkalinity	109	42	0.52	0.48
Mercury in water	<0.0001	<0.0001	<0.0001	<0.0001
Total solids	180	122	<10	<10
Total suspended solids	<4	<4	<4	<4
Total organic carbon	0.42	0.47	0.22	0.21
Nitrite & nitrate	<0.05	<0.05	<0.05	<0.05
Chloride	5.6	6.02	<1.0	<1.0
Calcium	0.87	4.9	0.071	0.052
Magnesium	0.39	1.6	0.002	0.001
Sodium	57	17	<0.30	<0.30
Sulfate	18	9.8	<1.0	1.8
Hardness (CaCO3)	3.8	18.8	0.2	0.1
Thallium	<0.5	<0.5	<0.5	<0.5
Silver	<0.040	<0.040	<0.04	<0.04
Beryllium	<0.001	<0.001	<0.001	<0.001
Antimony	<0.4	<0.4	<0.4	<0.4
Zinc	0.005	0.004	<0.004	<0.004
Arsenic	<0.0010	<0.0010	<0.0010	<0.0010
Selenium	<0.0020	<0.0020	<0.0020	<0.0020
Cadmium	0.00014	<0.0001	<0.0001	<0.0001
Chromium	<0.0010	<0.0010	<0.0010	<0.0010
Copper	<0.0005	<0.0005	0.0005	<0.0005
Nickel	0.0041	0.011	<0.0030	0.0065
Lead	<0.0020	<0.0020	<0.0020	<0.0020

(a) Both wells are screened in the Sparta Aquifer; samples collected August 1, 1990.
(b) Also referred to as the Arizona Well and USGS Well 172 located adjacent to Well CL-160. See Figure 2.5-11.
(c) Ludlow Corporation, Packaging Division located on the southern side of Homer.

Table 2.5-13

Summary of Aquifer Material Characteristics for Screened Intervals of Wells

Well	Sample Depth	Description	Natural Density (PCF)	Dry Density (PCF)	Porosity (%)	Specific Gravity	Moisture Content (%)	Total Carbon (%)
A-1	11'-13'	Light gray to yellowish red clayey silty fine to medium sand	125.3	108.8	33.7	2.63	15.2	0.03
A-1	35'-37'	Light yellowish brown silty clayey fine sand	131.1	102.2	37.3	2.61	28.2	0.02
B-1	15'-17'	Dark yellowish brown clayey fine sandy silt	117.1	91.6	43.1	2.58	27.8	0.30
C-1	33'-35'	Black clayey fine sandy silt	123.7	99.6	37.7	2.56	24.3	0.76
D-1	23'-25'	Dark olive gray silty fine sand	NA	NA	NA	2.60	NA	0.36
E-1	15'-17'	Brownish yellow clayey fine to medium very sandy silt	117.1	88.9	46.8	2.68	31.7	0.04
F-1	23'-25'	Yellowish brown silty clayey fine sand	123.7	94.7	42.5	2.64	30.7	BDL

NA = Not available; sample was disturbed.

Source: Samples described and analyzed by Duke Engineering and Services, Geotechnical Laboratory.

Table 2.5-14

Parameters Used in the Calculation of Groundwater Flow Rates

Well	Well Location (a) X-Coordinate	Well Location (a) Y-Coordinate	Water Level Elevation (b)	Screened Interval (c)	Screened Unit Description (c)	Hydraulic Conductivity (d)	Porosity (e)
A-1	1,853,396.97	791,525.39	311.26	28 - 38	Very fine to fine sand	0.3 ft/day (1.9 GPD/ft2)	37.3%
B-1	1,854,959.32	792,599.96	295.28	7 - 17	Silty to clayey sand	0.5 ft/day (3.9 GPD/ft2)	43.1%
C-1	1,852,206.08	790,067.42	270.53	30 - 40	Clayey silt	0.008 ft/day (0.1 GPD/ft2)	37.7%
D-1	1,853,070.58	792,610.73	305.99	18 - 23	Clayey sand	0.5 ft/day (3.6 GPD/ft2)	NA
E-1	1,854,563.26	790,069.09	311.33	8 - 18	Silty sand; fine to very fine	0.5 ft/day (4.0 GPD/ft2)	46.8%
F-1	1,853,679.41	791,095.99	310.43	20 - 30	Sand; fine to very fine, some silt and clay	3.0 ft/day (22.5 GPD/ft2)	42.5%

(a) As surveyed on August 9, 1990 by Doyle Sanders, registered land surveyor.
(b) Average of water levels measured on August 1 and 13, 1990. Elevations are relative to the NGVD of 1929.
(c) From ground surface and as logged by Jeff Robinson (ICF-Kaiser Engineers).
(d) See slug text analyses.
(e) From analysis by Duke Engineering and Services, Geotehcnical Laboratory.

NA = Not available; sample was disturbed.

Well locations shown on Figure 2.5-13.

Table 2.5-15

Chemical Data from Unfiltered Samples Collected from On-Site Groundwater Monitoring Wells
(mg/l)

Sample Identification	Well A-1	Well B-1	Well B-2	Well C-1	Well D-1	Well E-1	Well F-1
	Sampling Location						
Total alkalinity	5.9	4.5	71	62	42	1.5	1.7
Mercury in water	0.3	<0.1	0.18	1.1	<0.1	0.23	<0.1
Total solids	3786	1299	2330	1376	288	2009	349
Total suspended solids	3317	165	3690	980	116	1136	289
Total organic carbon	2.3	2.5	4.0	3.5	1.1	1.2	1.4
Nitrite + nitrate	0.64	1.0	0.09	0.11	<0.05	0.47	0.34
Chloride	4.8	8.0	7.0	4.3	4.6	4.6	4.5
Calcium	2.3	2.2	18	24	12	0.40	0.95
Magnesium	0.60	2.7	6.6	7.7	6.0	0.41	0.85
Sodium	4.4	3.3	9.7	16	6.7	2.2	2.9
Sulfate	7.0	5.8	39	83	52	7.3	15
Hardness (CaCO3)	5.7	16.6	72.1	91.6	29.9	1.7	5.9
Thallium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	<0.040	<0.040	<0.40	<0.40	<0.40	0.055	<0.040
Beryllium	0.003	0.001	0.004	0.001	<0.001	0.010	<0.001
Antimony	0.7	<0.4	1.6	<0.4	<0.4	1.4	<0.4
Zinc	0.067	0.70	0.35	0.087	0.039	0.32	0.015
Arsenic	2.1	5.4	36	6.4	2.9	9.5	1.3
Selenium	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Cadmium	0.75	0.59	0.82	1.4	0.21	1.2	0.67
Chromium	53	34	71	11	2.5	94	8.8
Copper	26	17	17	8.9	1.1	62	2.4
Nickel	<15	31	96	29	<6.0	73	5.0
Lead	24	26	31	11	2.2	45	3.6

Well locations are shown in Figure 2.5-13

Table 2.5-16

Chemical Data from Filtered Samples Collected from On-Site Groundwater Monitoring Wells
(mg/l)

Sample Identification	Sampling Location						
	Well A-1	Well B-1	Well B-2	Well C-1	Well D-1	Well E-1	Well F-1
Thallium	<0.5	<0.5	<0.5	<0.5	NS	<0.5	NS
Silver	<0.040	<0.040	<0.040	<0.040	NS	<0.040	NS
Beryllium	<0.001	<0.001	<0.001	<0.001	NS	<0.001	NS
Antimony	<0.4	<0.4	<0.4	<0.4	NS	<0.4	NS
Zinc	<0.004	<0.004	0.011	0.006	NS	0.016	NS
Arsenic	<1.0	<1.0	<1.0	<1.0	NS	<1.0	NS
Selenium	<2.0	<2.0	<2.0	<2.0	NS	<2.0	NS
Cadmium	0.44	0.49	0.75	1.1	NS	0.45	NS
Chromium	<1.0	<1.0	<1.0	<1.0	NS	<1.0	NS
Copper	3.0	17	7.0	16	NS	4.5	NS
Nickel	<3.0	<3.0	<3.0	<3.0	NS	<3.0	NS
Lead	<2.0	<2.0	<2.0	<2.0	NS	<2.0	NS

NS = Not sampled; turbidity was very low in the water from Wells D-1 and F-1 and therefore filtering of the samples was not necessary.

Well locations shown in Figure 2.5-13.

Table 2.5-17

Number of Persons Served by Public Water Supply Systems in Claiborne Parish, Louisiana (a)

Water System (b)	Population Served	
	Number of People	Percentage of Total
Athens Water Supply	450	2%
Haynesville Water Supply	6,400	29%
Homer Water Supply	7,275	34%
Lisbon Water Supply	700	3%
South Claiborne Water System	3,000	14%
Pine Hill Water Supply	510	2%
Wade Correctional Center	540	2%
Central Claiborne Water System	1,200	6%
Norton Shop Water System	155	1%
Summerfield Water System	750	3%
Middle Fork Water Supply	480	2%
Rambin-Wallace Water Supply	240	1%
TOTAL FOR CLAIBORNE PARISH:	21,700	100%

(a) (Reference 32)
(b) All of these systems obtain their water supply from groundwater.

Table 2.5-18

Assumptions Used for Modeling the Effects of Groundwater Withdrawals by the LES Facility with Withdrawals from the Central Claiborne Water System Well #4 (a)

Aquifer Transmissivity	15,000 gpd/ft^2 75,000 gpd/ft^2
Storativity	0.0001 (dimensionless)
LES Well Pumping Rates	5 gpm 15 gpm 50 gpm
Well #4 Pumping Rate	55 gpm
Duration of Pumping	30 years

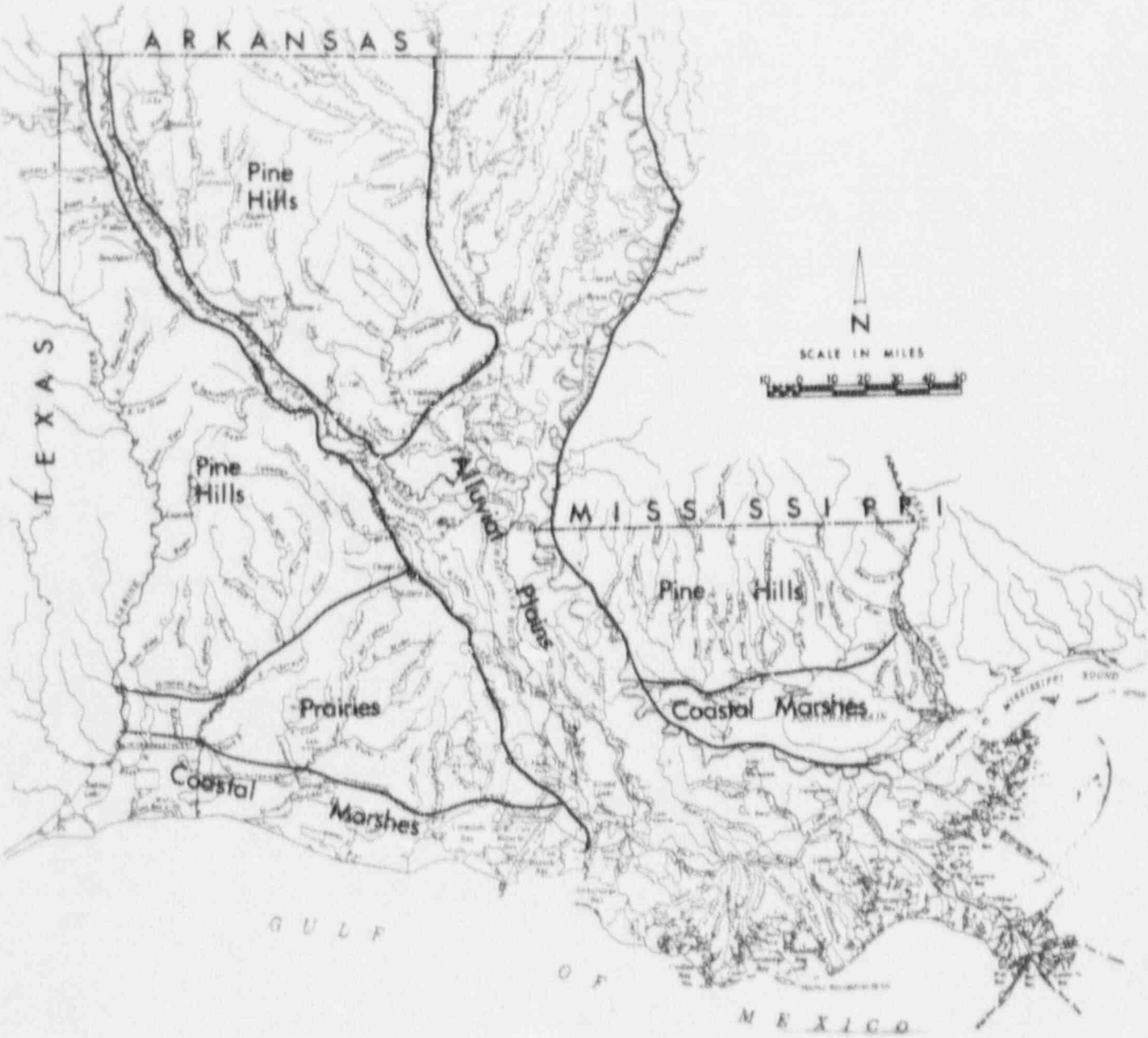
(a) See text for discussion.

Table 2.5-19

Estimated Groundwater Drawdown in the Sparta Aquifer
Based on Groundwater Withdrawals over 30-Years

	Drawdown (feet)		
	Contribution from Well #4	Contribution from LES Well	Total
Pumping 5 GPM from the LES Well			
Aquifer Transmissivity = 15,000 GPD/ft			
At the Southern Property Boundary (a)	3.53	0.43	3.96
At a Point Between the Wells (b)	4.11	0.34	4.45
At Well # 4 (c)	11.31	0.3	11.61
Aquifer Transmis[illegible]y = 75,000 GPD/ft			
At the S[illegible]uthern Property Boundary (a)	0.84	0.1	0.94
At a Point Between the Wells (b)	0.96	0.08	1.04
At Well # 4 (c)	2.4	0.07	2.47
Pumping 15 GPM from the LES Well			
Aquifer Transmissivity = 15,000 GPD/ft			
At the Southern Property Boundary (a)	3.53	1.28	4.81
At a Point Between the Wells (b)	4.11	1.03	5.14
At Well # 4 (c)	11.31	0.91	12.22
Aquifer Transmissivity = 75,000 GPD/ft			
At the Southern Property Boundary (a)	0.84	0.29	1.13
At a Point Between the Wells (b)	0.96	0.24	1.2
At Well # 4 (c)	2.4	0.22	2.62
Pumping 50 GPM from the LES Well			
Aquifer Transmissivity = 15,000 GPD/ft			
At the Southern [illegible]roperty Boundary (a)	3.53	4.27	7.8
At a Point Between the Wells (b)	4.11	3.43	7.54
At Well # 4 (c)	11.31	3.04	14.35
Aquifer Transmissivity = 75,000 GPD/ft			
At the Southern Property Boundary (a)	0.84	0.98	1.82
At a Point Between the Wells (b)	0.96	0.81	1.77
At Well # 4 (c)	2.4	0.73	3.13

(a) Approximately 0.5 miles from the proposed LES well location.
(b) Approximately 1.5 miles from the proposed LES well location.
(c) Approximately 2.5 miles from the proposed LES well location.

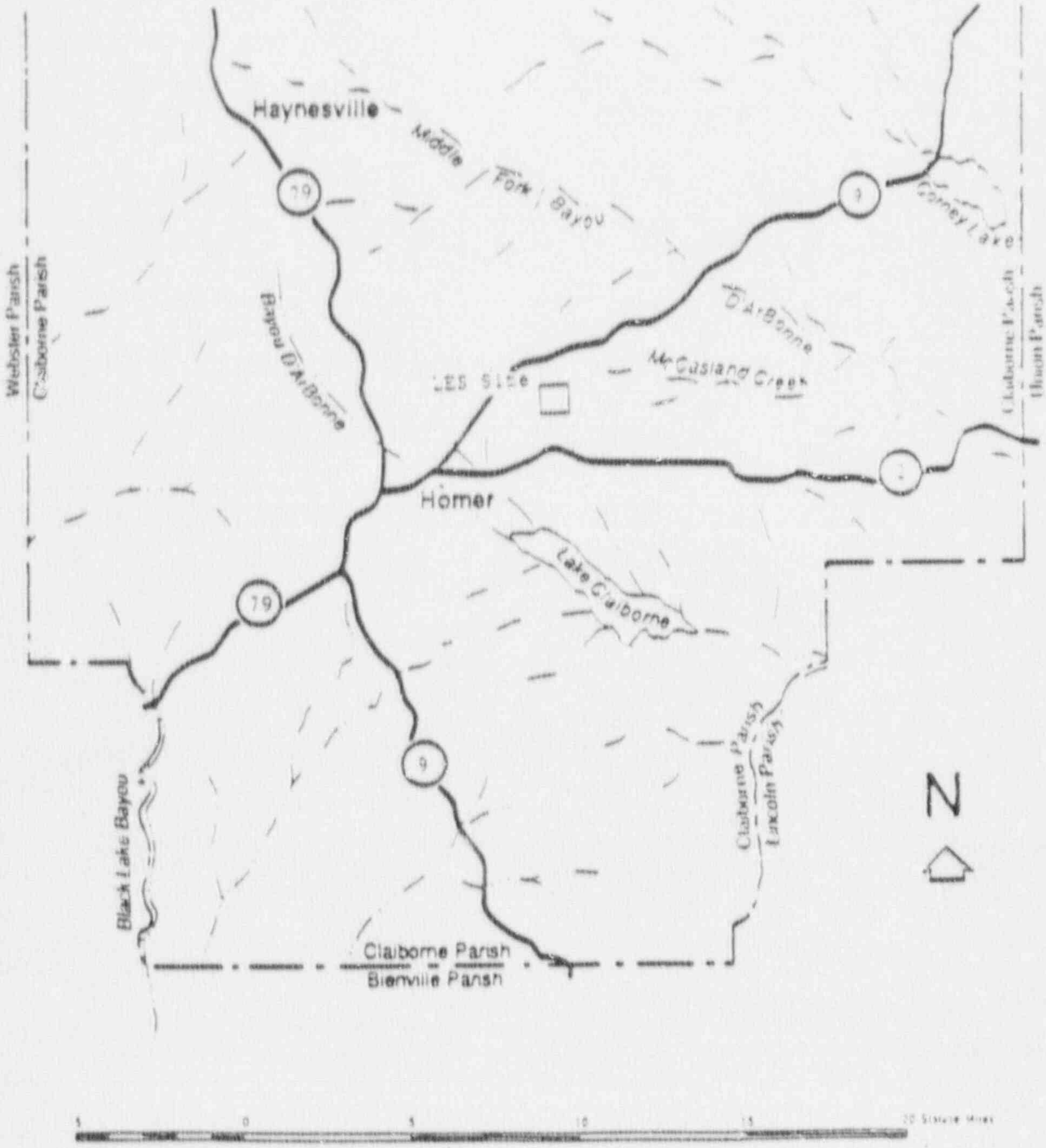


Reference: Floods in Louisiana, Magnitude and Frequency, 1964, U.S. Geological Survey and Louisiana Department of Highways.

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

Major Drainage Systems of Louisiana

Figure 2.5-1



CLAIBORNE ENRICHMENT CENTER

Major Surface Water Features in Claiborne Parish

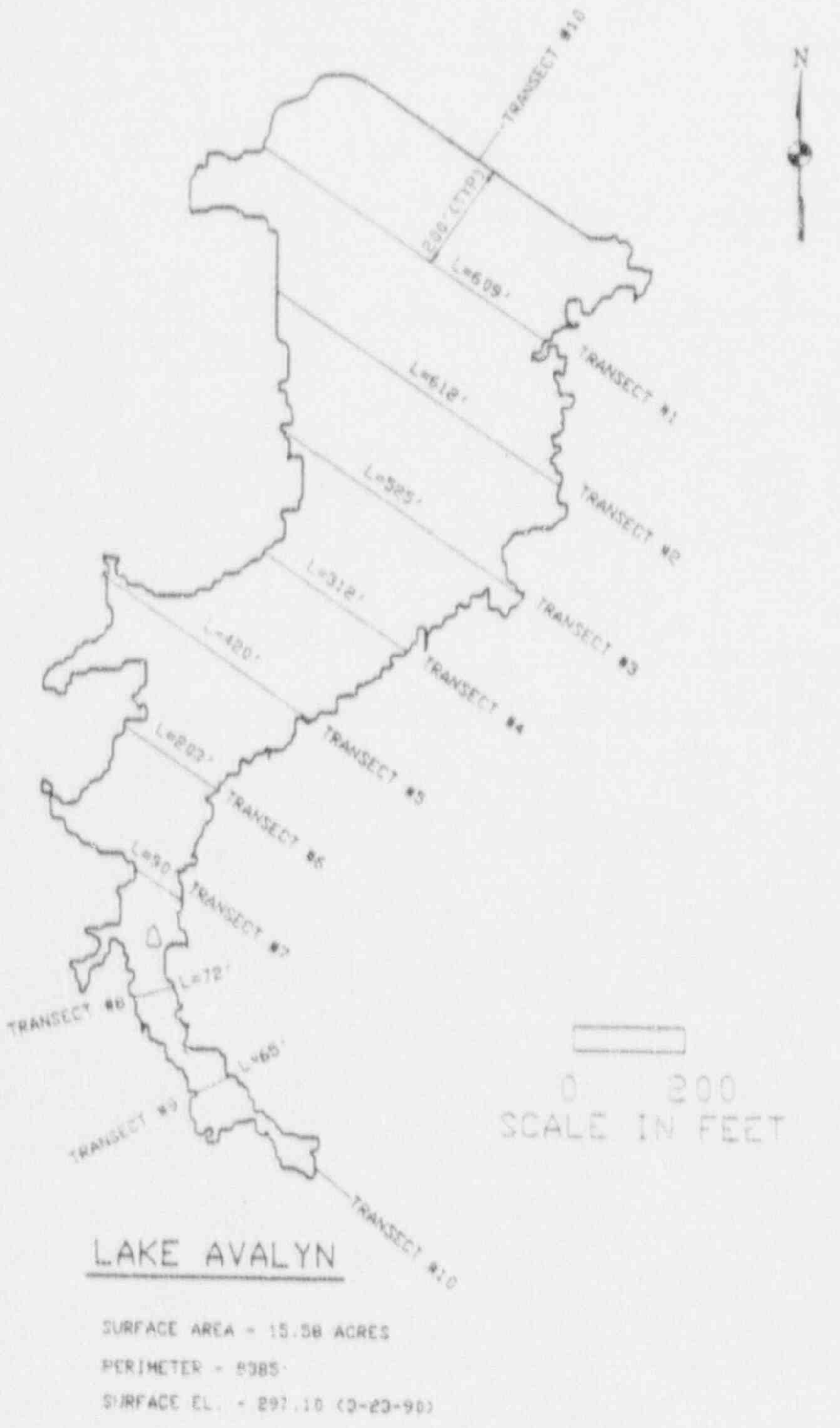
Figure 2.5-2

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Surface Water Drainage on the LES Property

Figure 2.5-3



LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Lake Avalyn Transects

Figure 2.5-4

TRANSECT #1 AREA = 5200 SQ.FT.

TRANSECT #2 AREA = 4290 SQ.FT.

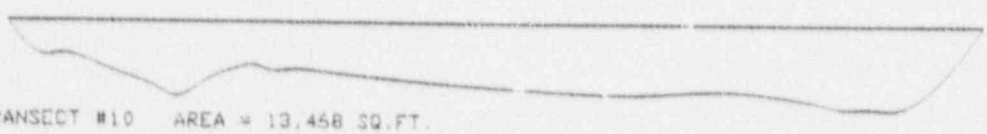
TRANSECT #3 AREA = 2781 SQ.FT.

TRANSECT #4 AREA = 1608 SQ.FT.

TRANSECT #5 AREA = 1978 SQ.FT.

TRANSECT #6 AREA = 1001 SQ.FT.

TRANSECT #7 AREA = 326 SQ.FT.



TRANSECT #10 AREA = 13,458 SQ.FT.

LAKE AVALYN CROSS SECTIONS

VERTICAL SCALE EXAGGERATED BY A FACTOR OF 10

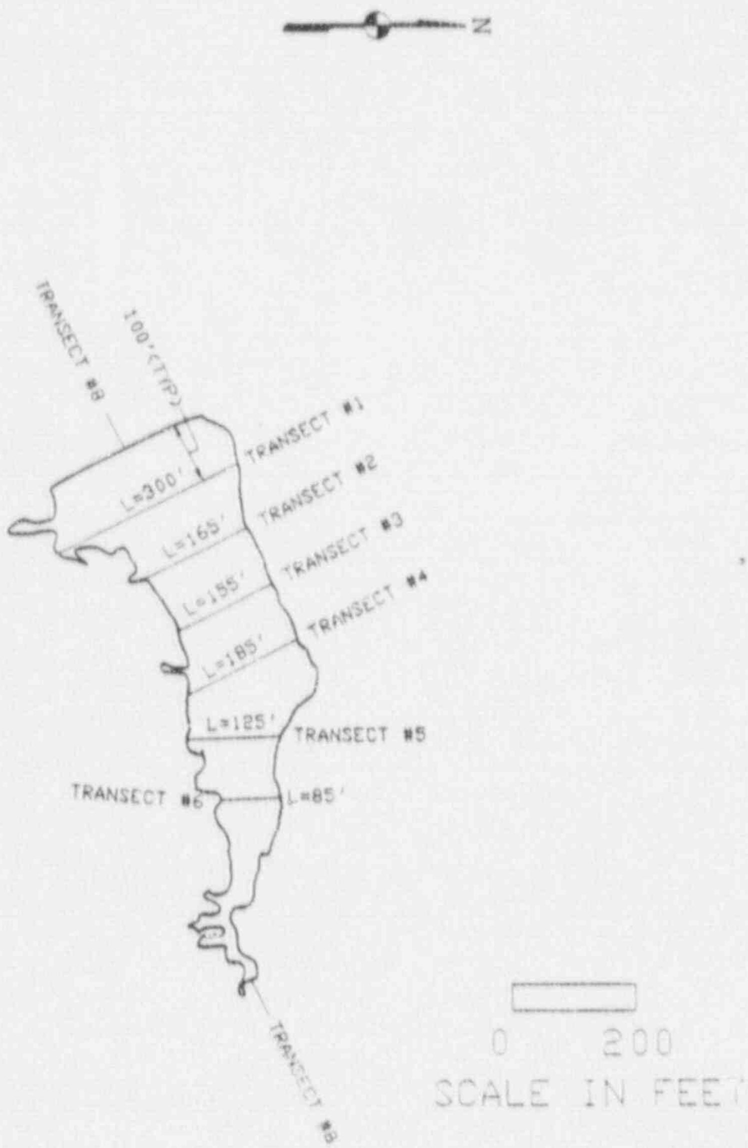
SURFACE AREA - 15.58 ACRES
VOLUME - 4 x 10^6 CU.FT.

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Lake Avalyn Cross Sections

Figure 2.5-5



BLUEGILL POND

SURFACE AREA - 2.6 ACRES

PERIMETER - 2166'

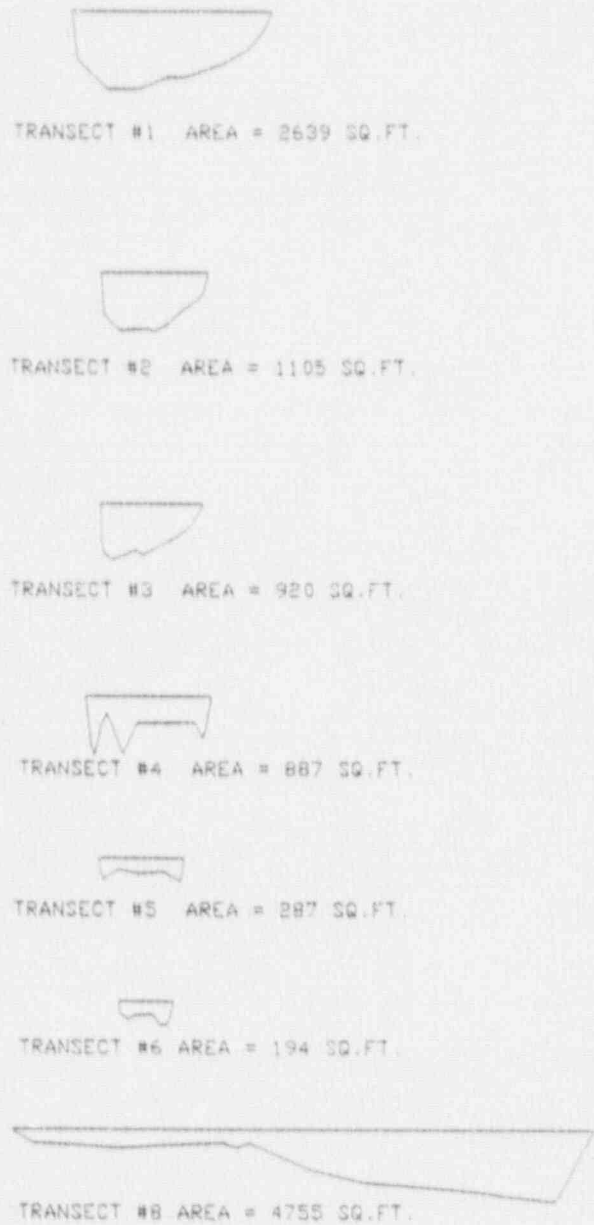
SURFACE EL. - 275.20 (3-23-90)

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Bluegill Pond Transects

Figure 2.5-6



BLUEGILL POND CROSS SECTIONS

VERTICAL SCALE EXAGGERATED BY A FACTOR OF 10

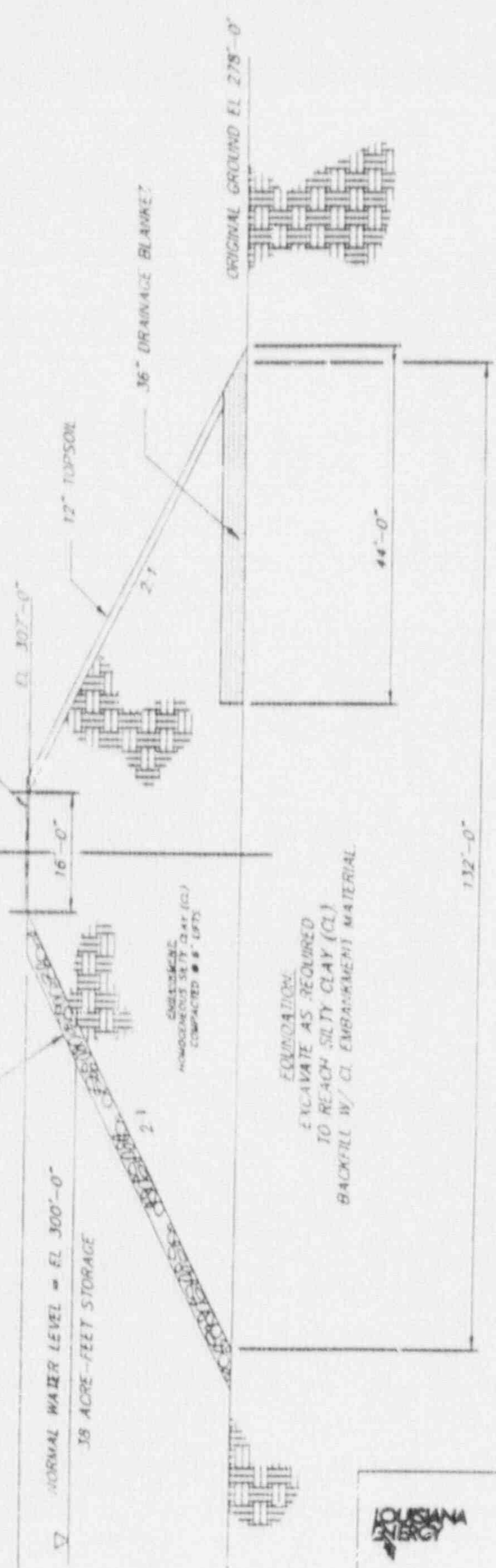
SURFACE AREA - 2.6 ACRES
VOLUME - 7.4×10^5 CU.FT.

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Bluegill Pond
Cross Sections

Figure 2.5-7

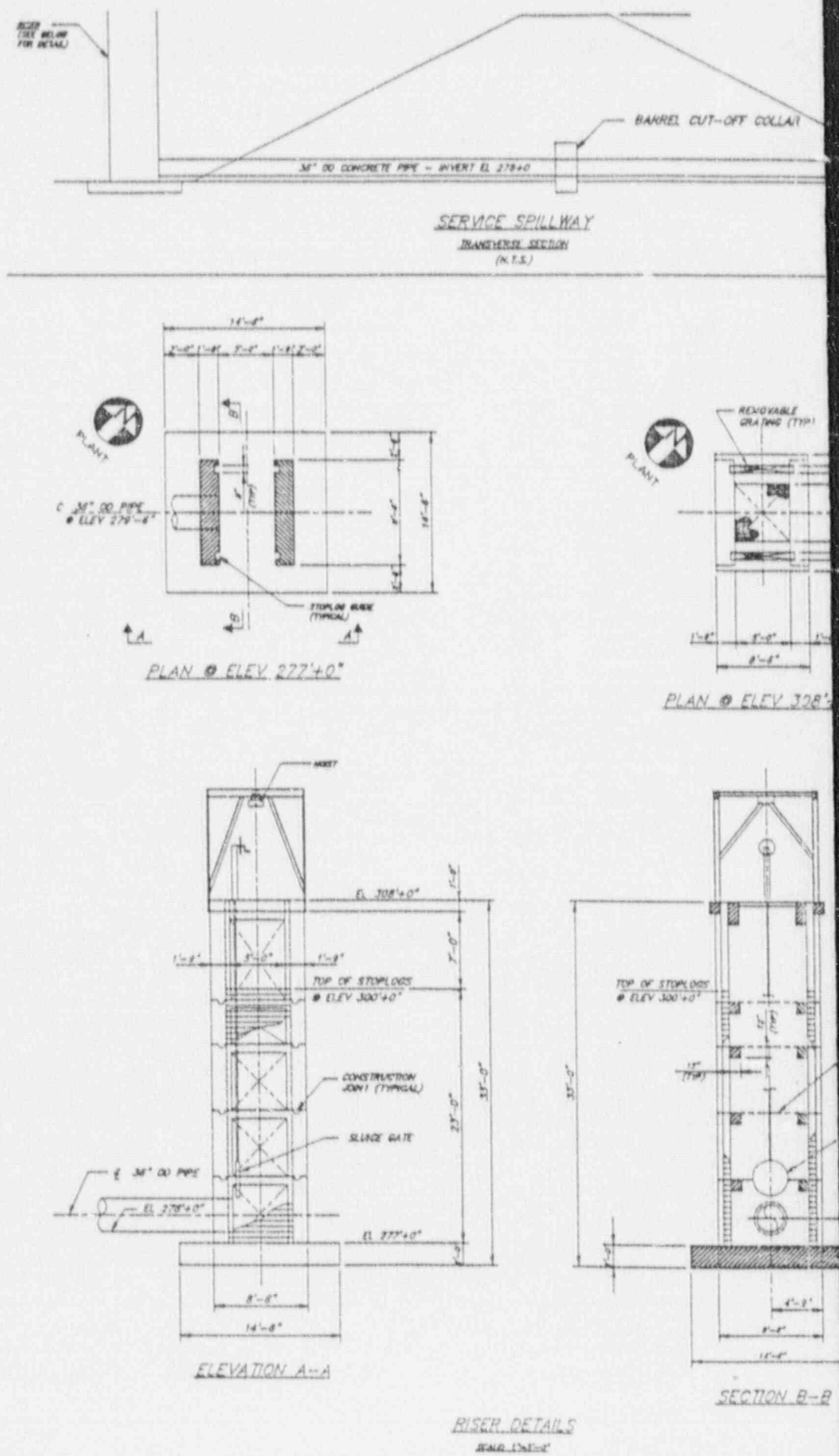


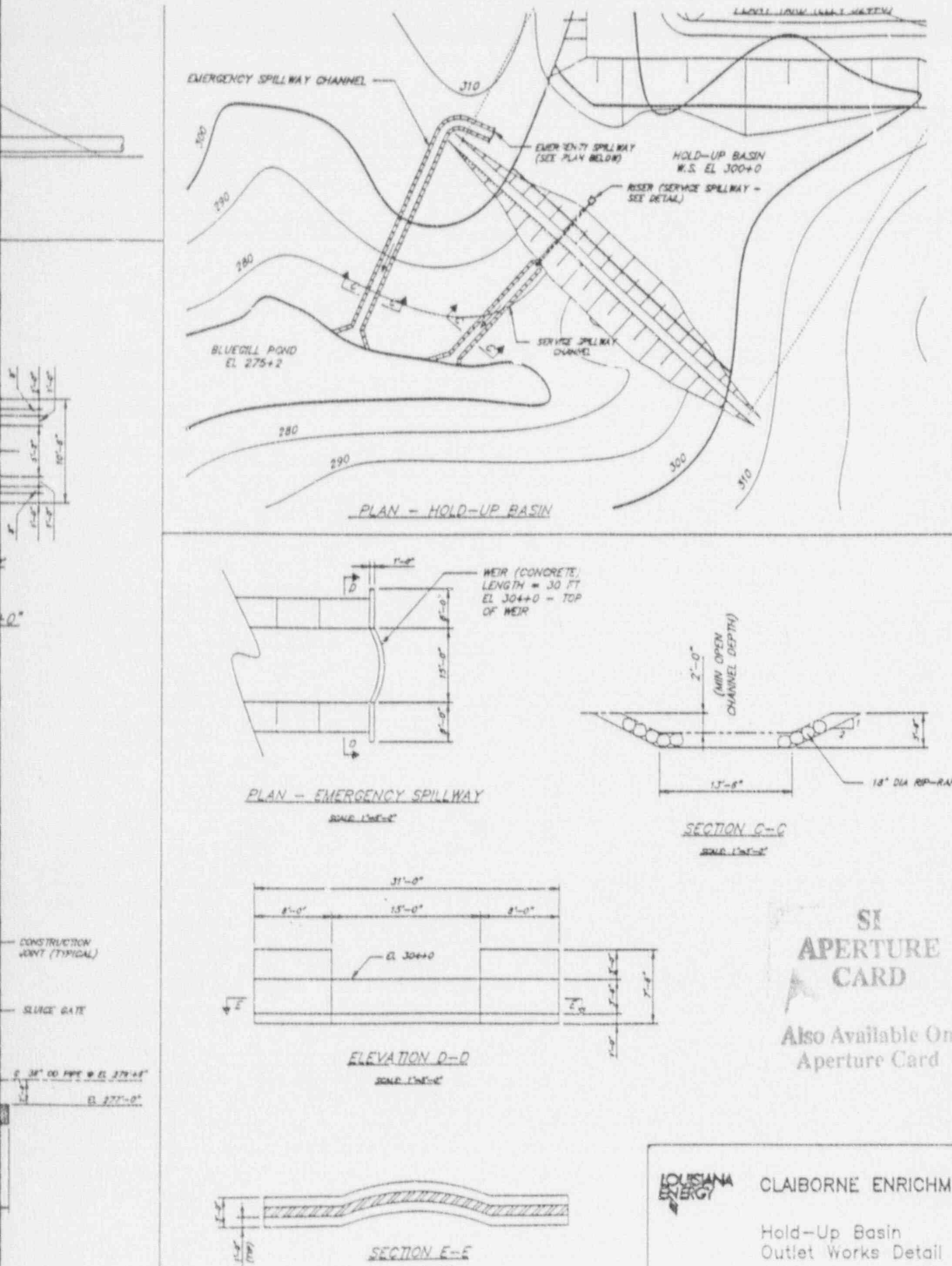
LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Hold-Up Basin Embankment
Maximum Cross Section

Figure 2.5-8


BARREL CUT-OFF COLLAR
36" OD CONCRETE PIPE – INVERT EL 278+0
SERVICE SPILLWAY
TRANSVERSE SECTION
(N.T.S.)
PLANT
REMOVABLE GRATING (TYP)
STOPLOG GUIDE (TYPICAL)
PLAN @ ELEV 277'+0"
HOIST
EL 308'+0"
TOP OF STOPLOGS @ ELEV 300'+0"
CONSTRUCTION JOINT (TYPICAL)
SLUICE GATE
EL 277'+0"
ELEVATION A–A
SECTION B–B
RISER DETAILS



SI
APERTURE
CARD

Also Available On
Aperture Card

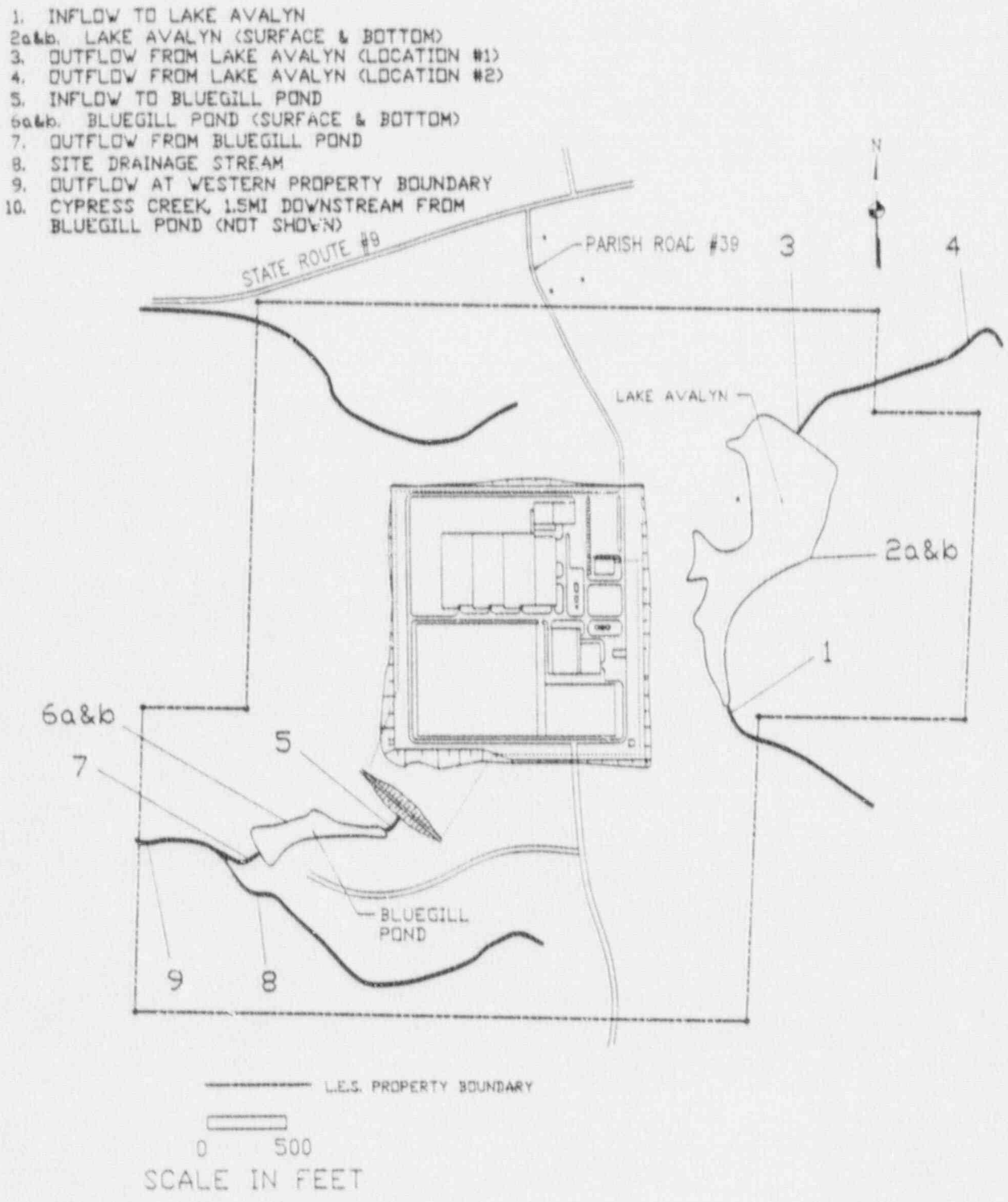
LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Hold-Up Basin
Outlet Works Detail

Figure 2.5-9

9102060114-09/01



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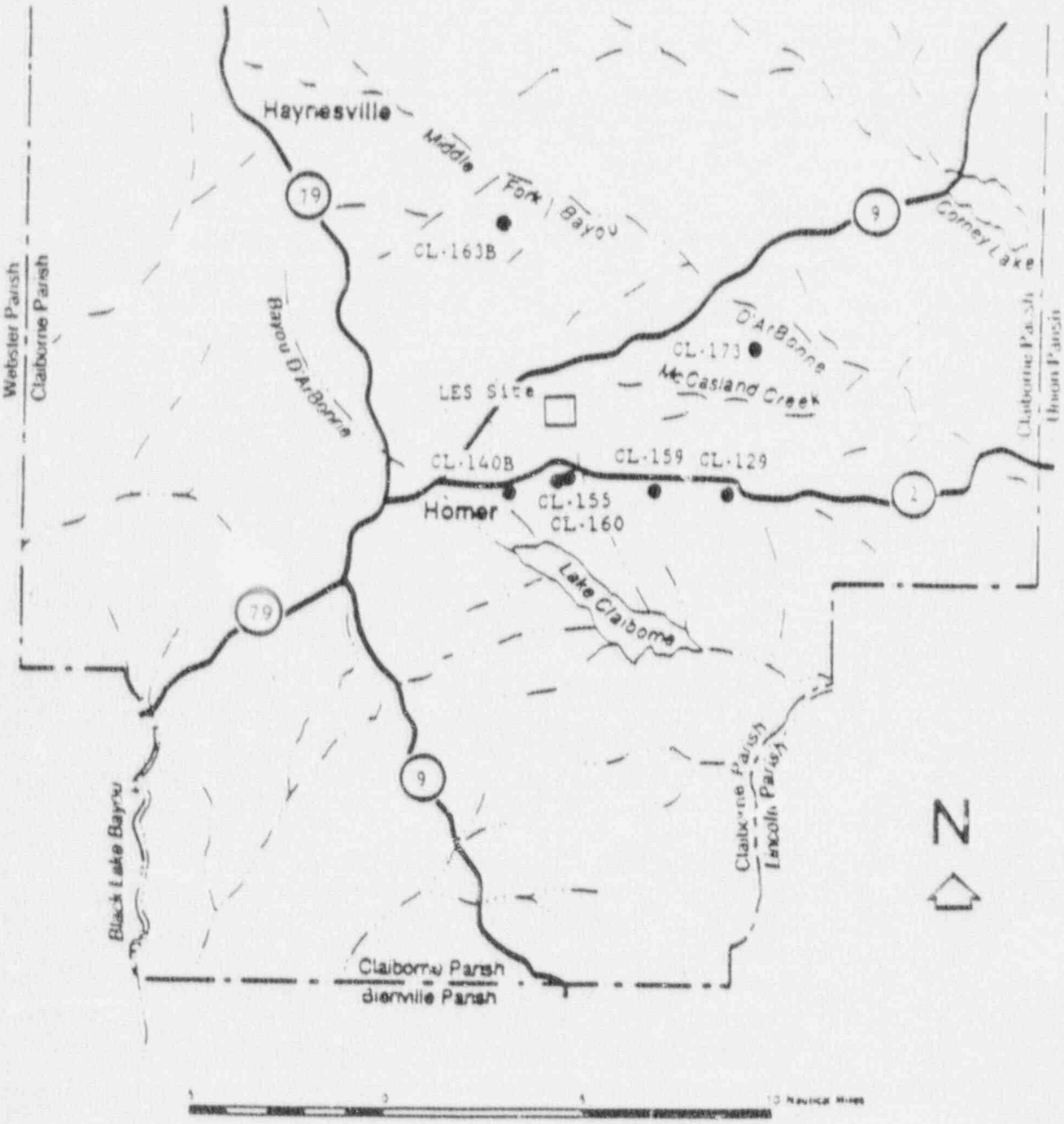
Surface Water Chemistry Sampling Locations

Figure 2.5-10



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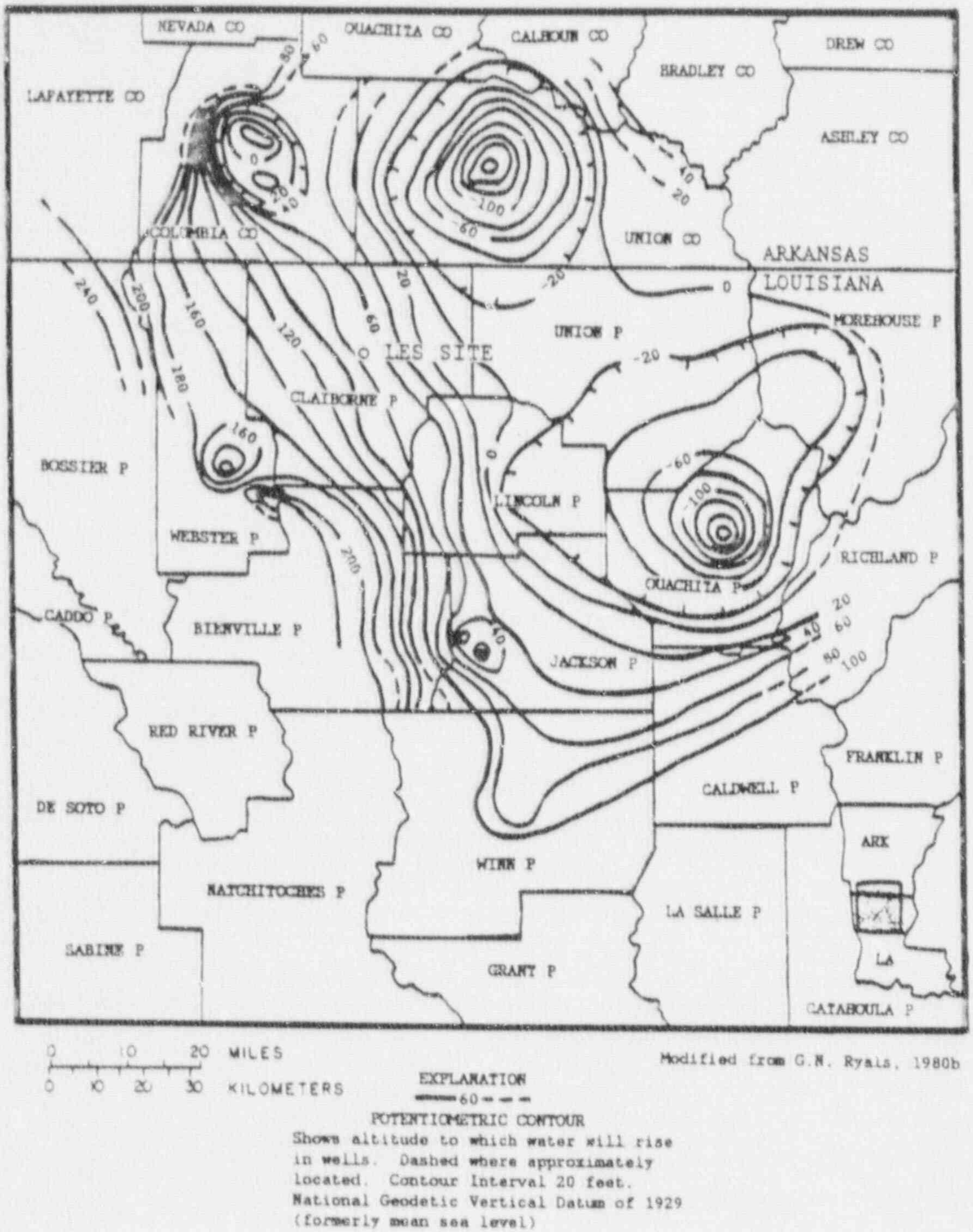
Location of Wells
Identified in Table 2.5-13

Figure 2.5-11



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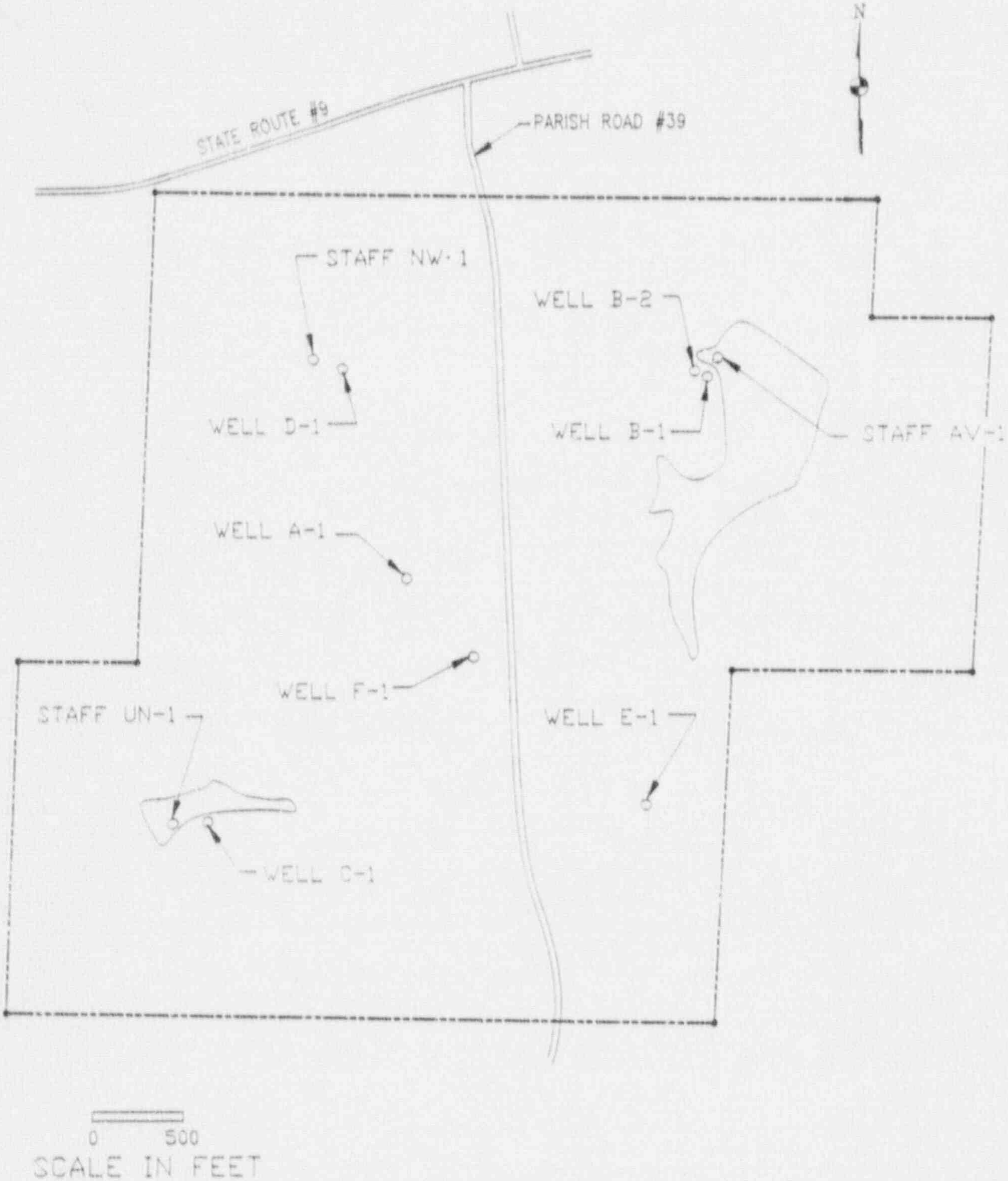
Potentiometric Surface of the Sparta Aquifer, Northern Louisiana and Southern Arkansas, Spring 1980

Figure 2.5-12



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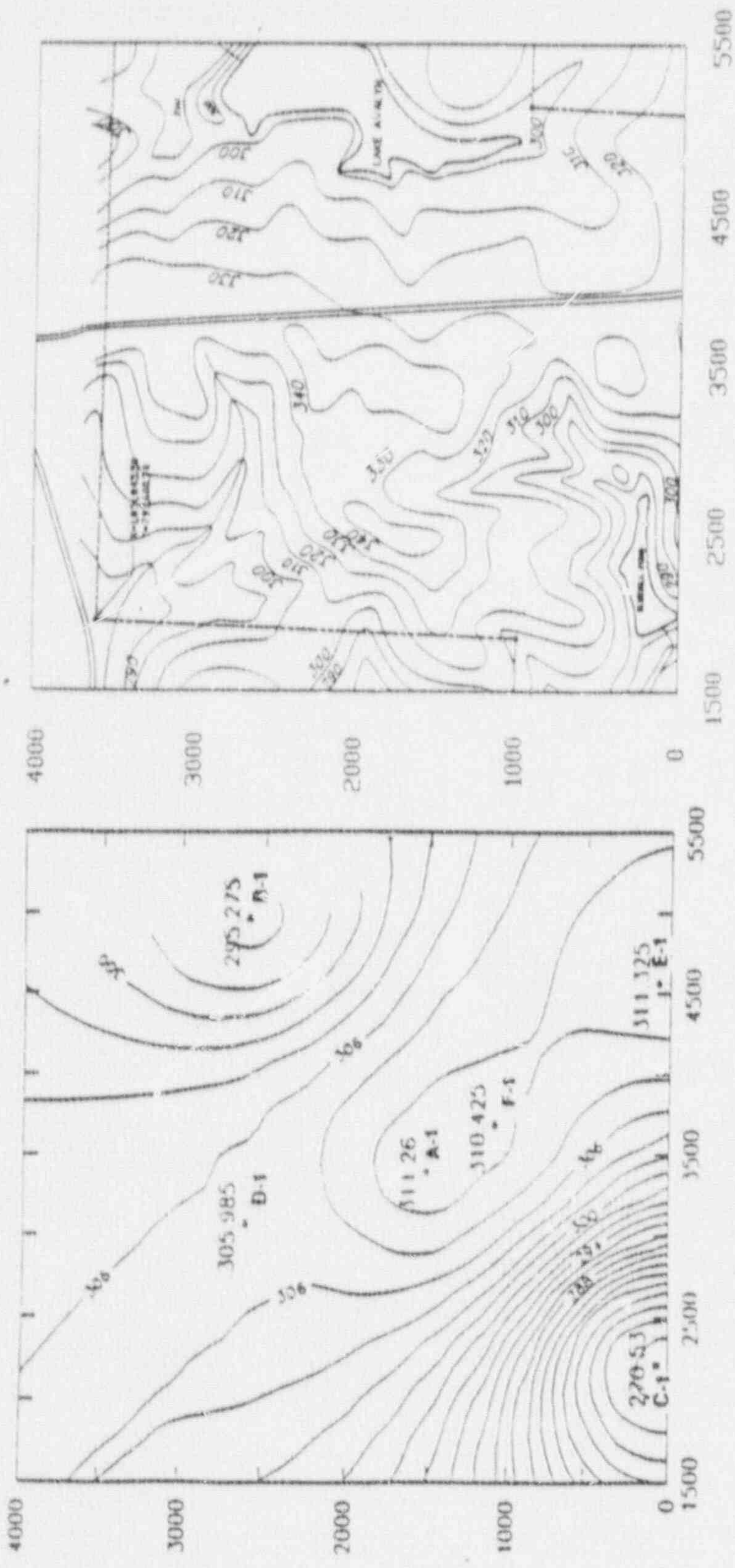
Locations of Site Monitoring Wells and Surface Water Staff Gauges

Figure 2.5-13



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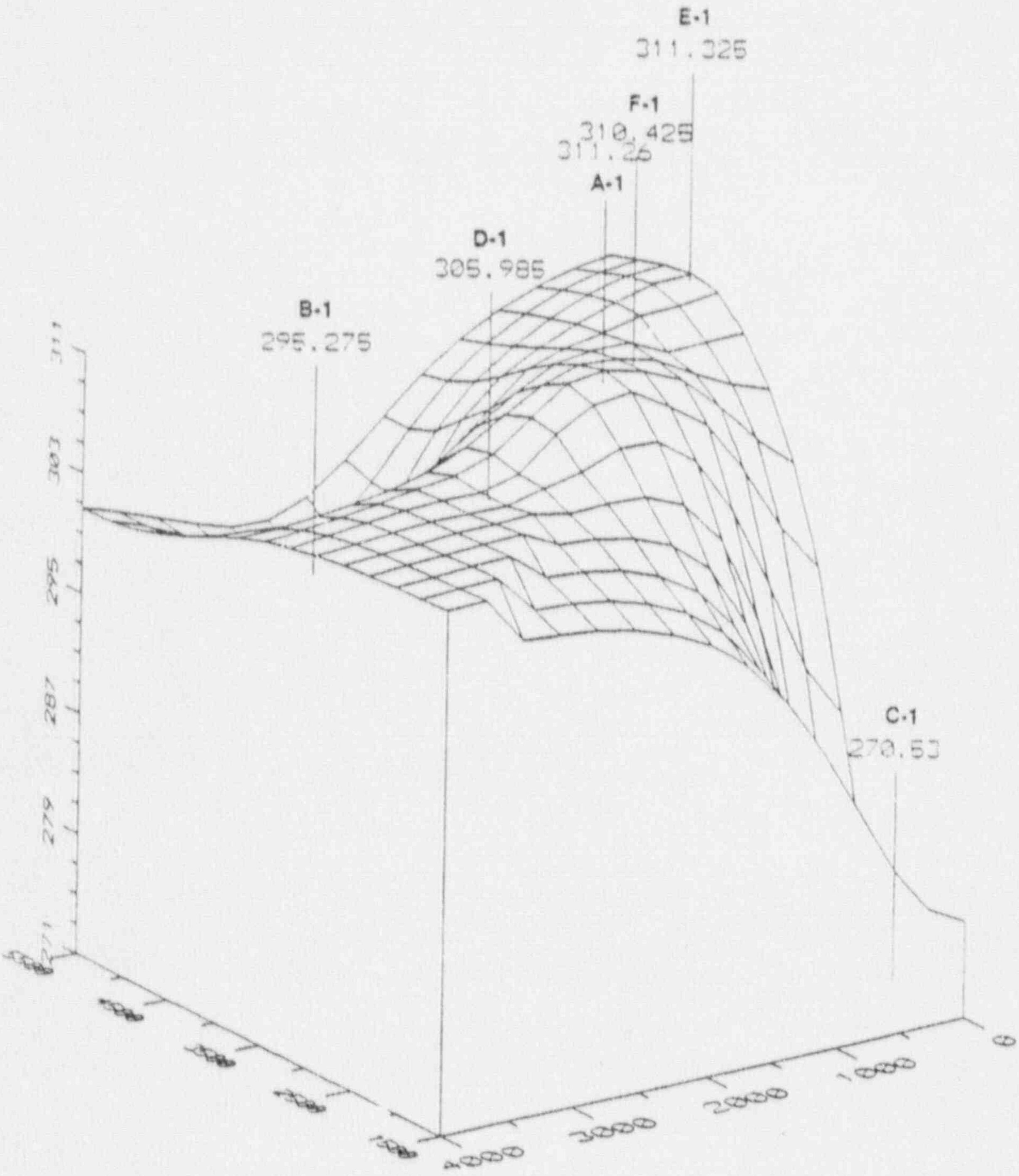
Contours of the Shallow Groundwater Beneath the LES Site and the Site Surface Topography (Elevations are in Feet)
Figure 2.5–14



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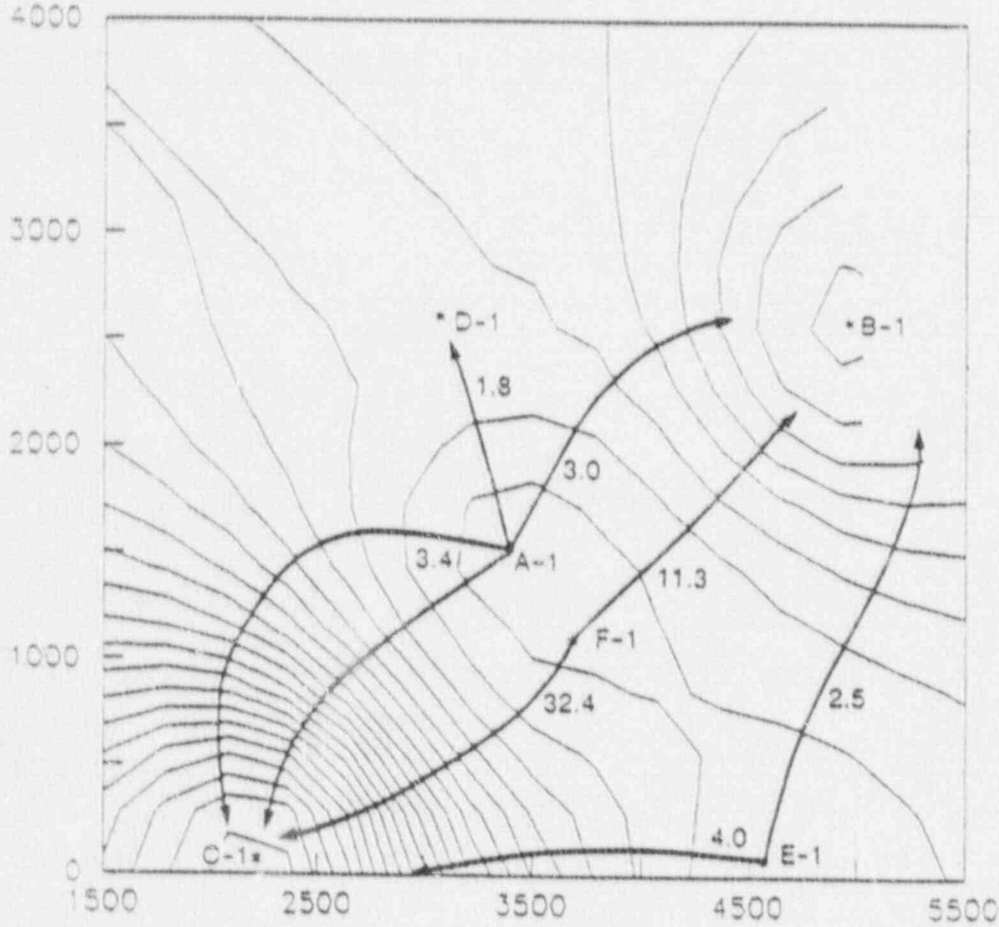
Three-Dimensional View of the Water Table Beneath the LES Property (Northwest to Southeast)
(Elevations are in Feet)
Figure 2.5-15



ARROWS INDICATE GROUNDWATER FLOW DIRECTION IN FEET PER YEAR

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Shallow Groundwater Contours and Average Linear Velocities Beneath the LES Site

Figure 2.5–16

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2.6 METEOROLOGY

In this section, data characterizing the meteorology (e.g., winds, precipitation, and temperature) for the site of the LES facility are presented along with discussions on severe storms, ambient air quality, and the impact of local terrain features on site meteorology.

2.6.1 ON-SITE METEOROLOGICAL CONDITIONS

The meteorological conditions at the CEC have been evaluated and summarized in order to characterize the site climatology and provide a basis for predicting the dispersion of gaseous effluents. The primary source of these data was the National Oceanic and Atmospheric (NOAA) Local Climatological Data (LCD) recorded at the Shreveport Regional Airport National Weather Service (NWS) Station approximately 45 mi west/southwest of the site. Observations taken at the Shreveport NWS station represent the most comprehensive set of meteorological data collected in the vicinity of the site. In the following summary of meteorological data from the Shreveport station (Reference 1), averages are based on a 30-year record (1951 to 1980), while extremes (which are based on a running average and, therefore, updated yearly) are based on a 36-year period of record ending in 1988.

Use of the Shreveport observations for a general description of the meteorological conditions at the CEC site and for predicting the dispersion of gaseous effluents was deemed appropriate for a number of reasons. First, the intervening terrain between the Shreveport station and the proposed site ranges from level to gently rolling. Therefore, there are no significant dissimilarities in elevation (such as deep valleys or large hills) that would cause differing meteorological conditions or air quality patterns. Second, both the Shreveport station and the CEC site are located far from the Gulf coast, so that neither is affected by local circulation features (e.g., land-sea breezes). Finally, the expert opinion of the meteorologist in charge at the Shreveport station concurred that the Shreveport data could be considered representative of the meteorological conditions at the facility location (Reference 2).

Although the Shreveport meteorological data were considered representative of the conditions at the CEC, the analysis of data conducted to characterize the meteorology of the site was not limited to the Shreveport data. The Louisiana State University Agricultural Center operates an observation station approximately 6 mi. southwest of the site in Homer, Louisiana. Daily observations of maximum and minimum temperatures, and total precipitation are recorded at this station and reported on a monthly basis to the Shreveport station. A limited amount of these data was available and is presented, along with the Shreveport data, in the appropriate following subsections. In addition, wind speed and direction data collected from two aviation weather stations in Monroe, Louisiana and El Dorado, Arkansas were obtained in an effort to evaluate regional wind flow patterns. The facility location is approximately at the centroid of a triangle formed by the Shreveport, El Dorado, and Monroe stations. Once again, a limited amount of data was available from the aviation weather stations and is presented in 2.6.1.3 which describes wind flow at the proposed site.

Operators of the Shreveport station and the LSU Homer station were contacted in order to determine any differences in data quality assurance/quality control (QA/QC) procedures among the four meteorological stations used to characterize the regional climatology. The Shreveport station stated that NWS stations and FAA stations (such as Monroe, Louisiana and El Dorado, Arkansas) apply the same QA/QC procedures (Reference 3). The LSU agricultural station reports that all data recorded there is sent to the NWS where the data undergo the same QA/QC as NWS and FAA data (Reference 4).

2.6.1.1 Temperature

The climate of Shreveport is transitional between the subtropical humid climate prevalent to the south, and the continental climates of the Great Plains and Middle West to the north. During the winter, moderate to severe cold air masses move through the area periodically. The summer months are quite warm, with maximum temperatures exceeding 100 F about 10 days/year and exceeding 95 F about 45 days/year (Reference 1).

Monthly average temperatures in Shreveport range from 46 F in January to 83 F in July. Recorded extreme temperatures for the 36-year period of record (1952 to 1988) are 3 F in January 1962 and 107 F in August 1962. The average relative humidity is rather high in all seasons (with percentages ranging approximately from the mid-60's to mid-70's). Highest humidities occur mainly during the early morning hours (Reference 1). For the Shreveport data, the daily and monthly averages and extremes of temperature, and the monthly averages of mean relative humidity are listed in Tables 2.6-1 and 2.6-2, respectively.

Monthly average temperatures in Homer range from 45 F in January to 81 F in July. Recorded extreme temperatures for the period of record 1951 to 1980 are -1 F in January 1962 and 107 F in August 1951 (Reference 5).

Presented in Figure 2.6-1 is a comparison of monthly average temperatures between Shreveport and Homer for the years 1951 through 1980. It can be seen that average monthly temperatures in Shreveport are consistently higher than in Homer by up to 2 F. This difference is indicative of an urban heat island effect which is attributable to Shreveport, a city of 204,000 population.

2.6.1.2 Precipitation

The normal annual total rainfall in Shreveport is approximately 45 in. Precipitation amounts are substantial from late autumn to spring, and there is a summer/early-autumn minimum with monthly averages less than 3 in. for August, September, and October. Record maximum and minimum monthly totals are 14.67 in. for June 1986 and 0.00 in. for October 1963, respectively. The highest 24-hr. precipitation total for the 36-year period was 7.17 in. for April 1953 (Reference 1). Table 2.6-3 lists the monthly averages and extremes of precipitation for the Shreveport data.

The normal annual total of rainfall in Homer is approximately 51 in., about 13% greater than in Shreveport. A record maximum monthly total of 13.95 in. occurred in August 1974 (Reference 5). A comparison of monthly average precipitation between Shreveport and Homer for the years 1951 through 1980 is presented in Figure 2.6-2. It can be seen that precipitation in Homer is greater than in Shreveport in all months except October. The higher precipitation in Homer is consistent with the rainfall gradient which extends across Northern Louisiana and is part of the overall climatological patterns associated with the Gulf of Mexico (Reference 6).

Snowfall in Shreveport averages less than 2 in./year; measurable amounts occur on an average of only once every other year and many consecutive years may pass with no measurable snowfall. A maximum monthly snowfall/ice pellets (for the 36-year period) of 5.9 in. fell in January 1978. The maximum amount of snowfall/ice pellets to fall in 24 hours was 5.6 in. for January 1982 (Reference 1). Table 2.6-4 lists the monthly averages and maximums of snowfall/ice pellets.

2.6.1.3 Wind

Although the Homer station is located nearest to the site, no wind data are collected at the Homer station. Wind data are available, however, for the Shreveport NOAA station and the Monroe and El Dorado FAA stations noted in 2.6.1. Refer to Figure 2.6-3 for the relative locations of the Shreveport, Monroe, El Dorado, and Homer stations with respect to the proposed site. For the purposes of comparison between stations, windspeed data in the following discussion has been adjusted to a height of 10 m where necessary.

The mean wind speed in Shreveport (for a 36-year period) is 9.0 mph. A maximum monthly average wind speed of 10.9 mph occurs in March. A minimum monthly average wind speed of 7.4 mph occurs in August. The fastest observed (1 min.) wind speed for the period of record was 56 mph and occurred in April 1975. The peak gust for the period was 69 mph and occurred in December 1987 (Reference 1).

The mean wind speed at El Dorado for a 5-year period (July 1949 to August 1954) is 7.0 mph. A maximum monthly average wind speed of 9.2 mph occurs in January and March. The minimum monthly average wind speed of 5.1 mph occurs in July.

The mean wind speed at Monroe for an 8-year period (January 1950 to December 1958) is 7.7 mph. The maximum monthly average wind speed of 9.8 mph occurs in March. The minimum monthly average wind speed of 5.8 mph occurs in August.

The lower annual average wind speeds noted above for El Dorado and Monroe relative to Shreveport are consistent with an observed annual average wind speed gradient which decreases roughly from east to west across Northern Louisiana and which is depicted in isopleth plots by Holzworth (Reference 7).

As a visual comparison of winds at all three meteorological stations, windroses (i.e., joint frequencies of wind speed and direction) based on 5 years of meteorological data at each site are presented in Figures 2.6-4, 2.6-5, and 2.6-6. Although the windroses are not based on the same 5-year period, they may be used as a means of comparing winds at the three sites. Burton et al. (Reference 8) indicate that a 5-year record of meteorological data adequately reduces the variability in air dispersion modeling results due to meteorological variability. The EPA has used the results of Burton et al. in deciding that 5 years is an adequate meteorological record length for use in air quality models when the data have been recorded at an off-site location (Reference 9). The stability of the joint frequency of wind speed and direction over a 5-year period is demonstrated specifically for Shreveport by comparing the windrose in Figure 2.6-6 which is based on data from 1970 to 1974, with the windrose in Figure 2.6-7, which is based on data from 1984 to 1988. The joint frequency distribution of wind speed, stability, and direction for the later data set, which has been used in the air dispersion modeling to assess the air quality impacts of the facility, is presented in Table 2.6-5 (see 4.2.1.2 and 5.1).

Figure 2.6-4 shows the predominant wind in El Dorado to be from the south, with strong components in the south-southeast, southeast, and north-northeast. Similar to El Dorado, Arkansas, the predominant wind in Shreveport, Louisiana, as indicated by Figures 2.6-6 and 2.6-7, is out of the south, with strong components in the south-southeast, southeast, and north. From Figure 2.6-5, it appears that the winds in Monroe, Louisiana are less focused with a predominant component out of the southeast and strong components in the north and south directions. At all three locations, wind blows weakly out of all points in the northwest quadrant.

The windroses in Figures 2.6-4, 2.6-5, 2.6-6, 2.6-7, and the information presented above clearly identify a discernable difference in the long-term winds at Shreveport, El Dorado, and Monroe. Consequently, one can conclude that the long-term wind patterns in Shreveport are likely not precisely representative of the winds in Homer, which is roughly at the centroid of the triangle formed by the three meteorological stations. Of what consequence this difference in wind patterns is to assessing the environmental impacts of the CEC facility, depends on the purpose the analysis of winds serves in the impact assessment. It is reasonably assumed that the wind data are most important in the assessment of the air quality impacts of the facility.

The NRC Regulatory Guide 4.9, Sections 4.2.1.2 and 5.1 (Reference 10), requires that χ/Q dispersion factors be used to assess the environmental effects of normal plant operations and facility accidents. In the absence of on-site meteorological data, the analysis may be conducted using data from 5-year National Weather Service summaries, provided applicability of these data to the proposed site is established. The χ/Q analysis has been conducted using meteorological data from Shreveport collected from 1984 to 1988 (the windrose in Figure 2.6-7 is based on these data) and the air dispersion algorithms prescribed in Regulatory Guide 1.111 (Reference 11). The purpose of this section of the report is to demonstrate that the Shreveport data are sufficiently representative of the actual regional meteorological conditions, and for Homer in particular, for the purposes of assessing the air quality impacts of the facility.

Assessment of the applicability of the Shreveport meteorological data to the LES facility was conducted by comparing χ/Q dispersion factors for the long-term average impact of emissions from the principle stacks at the facility using two sets of meteorological data. The first data set is the meteorological data collected from 1984 to 1988 in Shreveport and used to do the actual χ/Q analysis required for 4.2.1.2 and 5.1 of this report. The second data set is a composite of meteorological data collected in Shreveport from 1970 to 1974, in El Dorado from 1950 to 1954, and in Monroe from 1954 to 1958. It is hypothesized that such a composite data set may be equally or more representative of the long-term meteorological conditions in Homer than data which are based solely on Shreveport observations, because Homer is at the centroid of the triangle formed by three cities, and because there are no unusual geographic features near any of the three stations or Homer, such that the meteorological conditions at any of these localities might be significantly impacted by local geography. A slight amount of the difference in the data, however, may be attributed to varying degrees of the "urban heat island" effect at each of the meteorological stations, since they are located in or near cities of varying size. The impact of this effect on monthly average temperatures is addressed in 2.6.1.1.

Annual average χ/Q values for each of the two sets of meteorological data were calculated using the Industrial Source Complex Long Term (ISCLT) computer model. The ISCLT model is part of EPA's UNAMAP family of models which are considered to be EPA's preferred group of air models. It is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources (Reference 9). ISCLT may be used to estimate annual average ground level concentrations in all directions out to a distance of 50 km from the source of emissions.

The primary meteorological input to the ISCLT are summaries of the observed joint frequency of wind speeds and directions for a range of atmospheric stabilities, known as Stability Array (STAR) data. Graphical representations of the Shreveport and composite STAR data sets used in the ISCLT model are shown in Figures 2.6-7 and 2.6-8, respectively. Other meteorological data required by the ISCLT model include annual average ambient air temperatures and mixing heights for each stability class. As noted previously, the Shreveport meteorological data used in the ISCLT model are the same 1980 to 1984 data which were used in the actual χ/Q analysis in 4.2.1.2 and 5.1. The composite meteorological data are based on STAR and other necessary data contained in the Personal Computer Graphical Exposure Modeling System (PCGEMS) which has been developed by the EPA as a database and modeling system for the performance of exposure assessment studies (Reference 12). The composite data are essentially an average of the ISCLT input parameters obtained from PCGEMS for the three stations (Shreveport, Monroe, and El Dorado).

Other input parameters required by the ISCLT model include the physical dimensions of the stack and characteristics of the stack emissions. Options available in the ISCLT model include the use of urban or rural dispersion coefficients and the inclusion of building wake effects. The model was run in rural mode, and building wake effects were not considered, because it was determined that the CEC stacks met Good Engineering Practice (GEP) criteria. Although ISCLT will calculate the impacts from more than one source, only the emissions from a single stack were modeled. This was done because the stacks and emissions from each stack were assumed identical, and the stacks are located within close proximity of each other; the three stacks should have almost identical χ/Q values at the receptor locations of concern.

The ISCLT model was run for a polar receptor network comprised of 16 radials, one radial for every 22.5 degrees arc. Receptors were located along each radial at 100 m intervals out to 2600 m from the stack. The receptor network contained a total of 416 receptors which encircled the stack. As in the actual χ/Q analysis, all receptors were assumed to be at the terrain elevation of the stack base. Isopleths of the ground level χ/Q values for the Shreveport data and the composite data are presented in Figures 2.6-9 and 2.6-10, respectively. Because the predominant wind direction in both sets of data is from the south, the highest ground level χ/Q values are observed at receptors locations along the north azimuth. Receptor χ/Q values along the north azimuth for each data set are plotted in Figure 2.6-11. From this graph it can be seen that a maximum ground level χ/Q value of 0.63 $(\mu g/m^3)/(g/s)$ occurs 600 m from the stack using the Shreveport data and a maximum value of 0.49 $(\mu g/m^3)/(g/s)$ occurs 600 m from the stack using the composite data. This analysis indicates that the Shreveport data provide slightly higher maximum χ/Q values than the composite data but at the same downwind location. The difference of 28% between the maximum values obtained using ISCLT is well within the factor-of-two accuracy which is typically associated with Gaussian models (Reference 9). It may be concluded that a 5-year record of meteorological data from Shreveport is sufficiently representative of the long-term meteorological conditions in Homer for the purposes of assessing the impact of the LES facility on local air quality.

2.6.1.4 Storms

Thunderstorms occur during every month but are most common in spring and summer months. Thunderstorms occur an average of 55.7 days/year in Shreveport (based on a 36-year period of record). The seasonal average rates are: 17.7 days in spring (March through May); 21.5 days in summer (June through August); 9.8 days in fall (September through November); and 6.7 days in winter (December through February).

Severe local storms, including hailstorms, tornados, and local windstorms have occurred over small areas in all seasons but are most frequent during the spring months with a secondary peak from late November through early January. Large damaging hailstorms are infrequent, although hail as large as grapefruit fell in March 1961, and baseball size hail fell in May 1974 and April 1975 (Reference 1). For the period 1950-1987, a total of 632 tornados have been reported in a 3° latitude by 3° longitude square area surrounding the site (Reference 13). Tornados are commonly classified by their intensities. The F-Scale classification of tornados as defined in Fujita (Reference 14) is based on the appearance of damage which the tornado causes. The definitions for the six classifications, F0 to F5, are listed in Table 2.6-6. The breakdown of the intensity of the 632 tornados is as follows: 108 F0-class tornados; 256 F1-class tornados; 184 F2-class tornados; 74 F3-class tornados; 9 F4-class tornados; and 1 F5-class tornado (Reference 13). The number of tornado occurrences is based on a data set assembled by the National Severe Storm Forecast Center (NSSFC) in Kansas City, Missouri for the period 1950 to 1987 (reported in Reference 13). Figure 2.6-12 shows the paths of F4- and F5-class tornados that occurred in Louisiana over the period 1880 to 1982 (Reference 15). Table 2.6-7 contains a narrative description of each of these tornados. Based on these results, the paths of 8 F4-class tornados passed near the LES site during the 102-year period. A comparison between the number of F4-class tornados for the period 1880 to 1982 and for the period 1950 to 1987 is not possible, because the length of record and the size of the area analyzed for the two separate studies differ. A search for reported recent tornados (post 1982) occurring in Claiborne Parish identified only one. A complaint report filed with the Claiborne Parish Sheriff's Department in Homer, Louisiana stated that a possible tornado was sighted at approximately 12:45 a.m. on March 12, 1986, on Harmon Road near Lake Claiborne. Damages to homes and mobile homes were reported by residents. There also were reports of extensive tree damage. No classification was given to the possible tornado in this report.

Hurricanes are tropical storms that affect the Gulf and Atlantic coasts of the United States. These storms obtain their energy from ocean waters and consequently lose intensity following landfall. Claiborne Parish is located approximately 190 mi. from the Gulf of Mexico; therefore, the intensities of hurricanes are significantly reduced by the time they reach Northwest Louisiana. As an example, Hurricane Debra made landfall in 1978 and continued its track over northern Louisiana in the month of August. Annual extreme wind speeds in 1978 at Barksdale Air Force Base (which is located approximately 40 mi. southwest of the proposed site) were recorded in May rather than during passage of the hurricane. This indicates that Hurricane Debra wind speeds were not extreme when the storm reached northern Louisiana (Reference 13). In general, tropical cyclones dissipate considerably by the time they reach the northwest portion of the state. Wind speeds may be high but are not usually a destructive factor. However, associated heavy rainfall can contribute to local flooding (Reference 1).

2.6.2 EXISTING LEVELS OF AIR POLLUTION AND THEIR EFFECTS ON PLANT OPERATIONS

The area surrounding the CEC site is rural and undeveloped. There is little industry which impacts the ambient air quality in the region. With the exception of the pollutants discussed below, which are regulated by the State and Federal Government, there were no monitoring data available for ambient air in the vicinity of the site. Presented below, by pollutant, are discussions of the existing levels of air pollution based on monitoring in Northern Louisiana. Although normal operations at the facility will not result in emissions of the pollutants listed below, the following discussion verifies that the air quality in the region is very good and should have no impact on plant operations. Air emissions during site preparation and plant construction could include particulate matter and other pollutants; these potential emissions and their impacts are addressed in 4.1.

Particulate Matter

Total Suspended Particulate (TSP) measurements have been collected by the Louisiana Department of Air Quality (LDAQ) at a number of sites in Northern Louisiana. One of these stations, the Claiborne Public Health Unit, is located in Homer. The annual geometric mean 24-hr. average and the highest recorded 24-hr. average at the Homer station are plotted in Figure 2.6-13 for the years 1984 to 1988. Also included in the figure, as a potential indicator of rural background levels in Northwestern Louisiana, are the measurements recorded over the same time period at the Keel Radio Station in Dixie, Louisiana, a small town (population <2,500) located approximately 15 mi. north of Shreveport. The TSP measurements were taken at the Homer and Dixie stations over 24-hr. periods approximately every 6 days. Note that the standards are now based on particulate matter with a diameter less than or equal to 10 microns (PM_{10}). The PM_{10} is a small portion of the measured TSP; therefore, a direct comparison of TSP measurements to current PM_{10} standards is valid only in the sense that if TSP levels are below the PM_{10} standard, then PM_{10} levels will be much lower than the standard.

Comparing Figure 2.6-13 to the National Ambient Air Quality Standards (NAAQS) in Table 2.6-8 shows that both the annual average and short-term primary standards for PM_{10} were not exceeded in either Homer or Dixie over the 5-year period examined. The only measured exceedance of any PM_{10} standard at either station was a single exceedance in Dixie in 1985 of the short term secondary standard, i.e., 150 $\mu g/m^3$ averaged over 24 hours. The annual mean 24-hr. average in both Homer and Dixie appear relatively constant showing no decreasing or increasing trends. The Homer annual average is consistently about 20%

greater than the Dixie average. This is probably indicative of the fact that Homer is slightly larger than Dixie and is the locus of a greater quantity of vehicle traffic. The annual averages in both Homer and Dixie fall in the range between average concentrations which are generally considered associated with very clean air (20 $\mu g/m^3$) and those concentrations generally found in urban areas (60 $\mu g/m^3$ to 200 $\mu g/m^3$) (Reference 16).

Sulfur Dioxide

There are two LDAQ air quality monitoring stations in Northern Louisiana at which sulfur dioxide concentrations are measured. One is located at the Shreveport Downtown Airport, and the other is located at the airport in Monroe. Shreveport is a city with a population of 206,000, while Monroe is somewhat smaller with a population of 57,600. Sulfur dioxide concentrations are measured continuously at both stations.

Monthly maximum hourly average sulfur dioxide concentrations are plotted in Figure 2.6-14 over the 5-year record from 1984 to 1988. No trends in sulfur dioxide concentrations are discernable from this plot. The plot also shows that over the 5-year period no exceedances of the short-term primary NAAQS (a 24-hr. average of 0.14 ppm) in either city were measured. None of the other standards for sulfur dioxide listed in Table 2.6-8 were exceeded during the 5-year period. Annual mean concentrations, which are considerably less than the monthly maximums plotted in Figure 2.6-14, consistently fall in the 1 to 10 ppb range which has been identified as the range of sulfur dioxide concentrations in the "clean" troposphere (Reference 16).

In order to assess whether either or both of the sulfur dioxide measurements from Shreveport and Homer may be representative of sulfur dioxide levels in Northern Louisiana in general, and in Homer specifically, statistical analysis was performed on the data plotted in Figure 2.6-14. Correlation analysis showed the maxima at both stations to be slightly correlated, with a correlation coefficient equal to 0.30. The sample means, 0.0227 ppm in Monroe and .0199 ppm in Shreveport, were found not to be statistically different (using a t-test at a confidence level of 0.99). It can be concluded that the sulfur dioxide levels measured in Monroe and Shreveport are primarily due to sources other than local, and that they are typical of the levels found in other areas of Northern Louisiana, such as Homer, which are not impacted by local sources.

Ozone

Ozone monitoring has been conducted by LDAQ at the Keel Radio Station in Dixie and at the airports in Monroe and Shreveport. Ozone levels are monitored continuously at all three air quality stations. Monthly maximum hourly average ozone concentrations at the three stations from 1981 to 1988 are plotted, where data are available, in Figure 2.6-15; 1981 is the earliest that measurements were taken at any of the three stations. The complete, available record was plotted because an initial 5-year plot showed some evidence of a slight worsening of ozone concentrations over time. However, the 8-year plot does not reinforce this observation.

As indicated in Table 2.6-8, the NAAQS for ozone require that the average number of times per year that a 1-hr. average of 0.12 ppm is exceeded is no greater than 1. Between 1981 and 1988, a 1-hr. average of 0.12 ppm was exceeded 4 times in Shreveport (July 1981, July 1982, August 1983, and August 1985), once in Monroe (August 1985), and once in Dixie (July 1981). Such rates of exceedance are well within an average of 1/year. Background levels of ozone in the "clean" troposphere vary from lows of about 20 ppb in the fall to highs of about 80 ppb in the spring (Reference 16). The concentrations measured in Northern Louisiana appear to be roughly 50% greater than these background values.

As was done with the sulfur dioxide measurements, statistical comparisons were performed on the ozone data plotted in Figure 2.6-15. The analysis was limited to the data from 1984 to 1988, which is the last 5 years for which the data set is complete. Strong correlation was found among the monthly maximums at all three locations. For example, the correlation coefficient for the Shreveport and Dixie data is 0.83. Such correlation is expected considering that ozone formation is highly dependent on climatic conditions. The sample means on the monthly maximums at Dixie, Monroe, and Shreveport were found to be 0.0853 ppm, 0.0790 ppm and 0.0823 ppm, respectively. The difference in the means of the differences of the monthly maxima for Dixie and Monroe only, was found to be statistically significant at a confidence level of 0.99. (T-tests were performed on the differences of the monthly maximums because the data were shown to be strongly correlated.) Dixie is near enough to Shreveport that ozone levels in Dixie are probably impacted by ozone formation over Shreveport, the most urban of the three areas. Consequently, the slightly lower ozone levels measured in Monroe are probably the most representative of those found in Homer, which is less urbanized than either Shreveport or Monroe and is not near any urban centers as is Dixie.

Lead

The 1985 EPA Annual Statistics on Air Quality reports on 23 measurements of atmospheric lead concentrations taken in Shreveport (Reference 17). The minimum, median, and maximum levels measured were 0.03 $\mu g/m^3$, 0.10 $\mu g/m^3$, and 0.30 $\mu g/m^3$, respectively. These levels are well below the NAAQS primary standard of a mean of 1.5 $\mu g/m^3$ over any calendar quarter. Current levels in Homer are likely even lower because Homer is much less urbanized, and the number of cars presently using leaded gasoline presumably is much smaller now than in 1985.

Nitrogen Dioxide

The 1985 EPA Annual Statistics on Air Quality include statistics for measured 24-hr. average concentrations of nitrogen dioxide in Monroe and Shreveport (Reference 17). The geometric mean concentrations are 22.7 $\mu g/m^3$ and 21.1 $\mu g/m^3$ for Monroe and Shreveport, respectively. The maximum measured 24-hr. averages were 57 $\mu g/m^3$ and 54 $\mu g/m^3$ for Monroe and Shreveport, respectively. The means are well within the NAAQS primary standard of an annual mean concentration of 100 $\mu g/m^3$. Similar nitrogen dioxide levels are likely found in Homer.

2.6.3 THE IMPACT OF THE LOCAL TERRAIN AND LARGE LAKES AND OTHER BODIES OF WATER ON METEOROLOGICAL CONDITIONS

Local terrain in the form of hills, valleys, and large water bodies can have a significant impact on the meteorological conditions. In the vicinity of the facility, the terrain can be described as ranging from flat to gently rolling. This terrain will not cause significant impacts on meteorological conditions such as channeling of wind flows, development of drainage winds, and orographic precipitation.

Located approximately 4 mi south of the CEC facility is Lake Claiborne. Due to its size (approximately 5,800 acres), this lake could impact the local meteorological conditions by increasing the moisture content in the local atmosphere. The result could be increased formation of fog in low lying areas and increases in the amount of precipitation relative to the Shreveport area. However, as discussed in 2.6.2.3, the greater amount of precipitation observed in Homer relative to Shreveport is likely primarily due to the more regional climatological variations associated with the Gulf of Mexico. It is also unlikely that the lake is large enough to be responsible for the development of local circulation patterns (lake breezes) that could impact the facility because of the distance and the forested regions between the lake and the LES facility.

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Table 2.6-1

CEC Facility Climatological Summary--Temperature (F)[a]
Shreveport Meteorological Data

Month	Daily (b) Maximum	Daily (b) Minimum	Monthly (b)	Record Highest (b)	Year (b) Occurred	Record Lowest (b)	Year (b) Occurred
January	55.8	36.2	46.9	84	1972	3	1962
February	60.6	39.0	49.8	89	1986	12	1978
March	68.1	45.8	57.0	92	1974	20	1980
April	76.7	54.6	65.7	94	1987	31	1987
May	83.5	62.4	73.0	95	1977	42	1960
June	90.1	69.4	79.8	101	1988	52	1977
July	93.3	72.5	82.9	106	1980	58	1972
August	93.2	71.5	82.4	107	1962	54	1986
September	87.7	66.5	77.1	103	1980	42	1984
October	78.9	54.5	66.7	97	1954	31	1980
November	66.8	44.5	55.7	88	1984	16	1976
December	59.2	38.2	48.7	84	1955	6	1983
Year	76.2	54.6	65.4	107	1962	3	1962

(a) (Reference 1)
(b) Based on a 36-year record.

Table 2.6-2

CEC Facility
Climatological Summary--Fog/Humidity[a]
Shreveport Meteorological Data

Month	Mean Number of Days of Heavy fog[b]	Mean Relative Humidity[c]
January	3.5	72
February	2.2	69
March	1.4	67
April	1.2	70
May	0.8	73
June	0.5	73
July	0.3	72
August	0.5	71
September	1.1	73
October	2.4	71
November	2.8	73
December	2.9	74
Year	19.4	71

[a](Reference 1)
[b]Based on a 36-year record.
[c]Computed by arithmetically averaging 00, 06, 12, and 18 LST humidity readings.

Table 2.6-3

CEC Facility Climatological Summary--Precipitation (in)[a]
Shreveport Meteorological Data

Month	Normal[b] Monthly	Maximum[b] Monthly	Year[b] Occurred	Minimum[b] Monthly	Year[b] Occurred	Maximum[b] 24-Hour	Year[b] Occurred
January	4.02	10.09	1974	0.27	1971	3.18	1979
February	3.46	8.57	1983	0.90	1954	3.53	1965
March	3.77	7.23	1969	0.56	1966	3.63	1979
April	4.71	11.19	1957	0.43	1987	7.17	1953
May	4.7	11.78	1967	0.42	1988	5.27	1978
June	3.54	14.67	1986	0.13	1988	7.06	1986
July	3.56	9.46	1972	0.15	1964	4.30	1972
August	2.52	6.83	1955	0.35	1985	4.64	1955
September	3.29	9.59	1968	0.17	1956	5.39	1961
October	2.63	12.05	1984	0.00	1963	3.88	1957
November	3.77	10.81	1987	0.71	1967	6.51	1987
December	3.87	10	1982	0.59	1981	3.35	1965
Year	43.84	14.67	1986	0.00	1963	7.17	1953

[a](Reference 1)
[b]Based on a 36-year record.

Table 2.6-4

CEC Facility
Climatological Summary--Snow/Sleet (in)[a]
Shreveport Meteorological Data

Month	Normal[b] Monthly	Maximum[b] Monthly	Year[b] Occurred	Maximum[b] 24-Hour	Year[b] Occurred
January	0.3	5.9	1978	5.6	1982
February	0.2	4.40	1985	4.4	1985
March	0.1	4	1965	4.0	1965
April	0	0.3	1987	0.3	1987
May	0	0	NA	0.0	NA
June	0	0	NA	0.0	NA
July	0	0	NA	0.0	NA
August	0	0	NA	0.0	NA
September	0	0	NA	0.0	NA
October	0	0	NA	0.0	NA
November	0	1.3	1980	1.3	1980
December	0.1	5.4	1983	5.4	1983
Year	0.6	5.9	1978	5.6	1982

NA = Not Applicable

[a](Reference 1)
[b]Based on a 36-year record.

Table 2.6-5

Joint Frequency Distribution of Wind Speed and Direction by Stability Class for Shreveport LCD Station (1984 to 1988)

Wind Sector	Wind Speed Category Midpoints at Anemometer Height (20 ft), m/s					
	1.5	2.5	4.3	6.8	9.5	12.5
			Stability Class A			
N	0.001443	0.003151	0.002215	0.000000	0.000000	0.000000
NNE	0.000705	0.001644	0.001279	0.000000	0.000000	0.000000
NE	0.000708	0.001849	0.001233	0.000000	0.000000	0.000000
ENE	0.000669	0.001575	0.000936	0.000000	0.000000	0.000000
E	0.001240	0.002466	0.001758	0.000000	0.000000	0.000000
ESE	0.001084	0.002100	0.001324	0.000000	0.000000	0.000000
SE	0.001201	0.002922	0.001667	0.000000	0.000000	0.000000
SSE	0.001146	0.002169	0.001553	0.000000	0.000000	0.000000
S	0.001965	0.004247	0.003562	0.000000	0.000000	0.000000
SSW	0.000940	0.002009	0.001758	0.000000	0.000000	0.000000
SW	0.001064	0.002329	0.002283	0.000000	0.000000	0.000000
W	0.001266	0.002648	0.001781	0.000000	0.000000	0.000000
WNW	0.001263	0.002443	0.001781	0.000000	0.000000	0.000000
NW	0.000770	0.001370	0.000662	0.000000	0.000000	0.000000
NNW	0.000708	0.001849	0.001050	0.000000	0.000000	0.000000
NW	0.000767	0.001530	0.000936	0.000000	0.000000	0.000000
			Stability Class B			
N	0.001443	0.003151	0.002215	0.000000	0.000000	0.000000
NNE	0.000705	0.001644	0.001279	0.000000	0.000000	0.000000
NE	0.000708	0.001849	0.001233	0.000000	0.000000	0.000000
ENE	0.000669	0.001575	0.000936	0.000000	0.000000	0.000000
E	0.001240	0.002466	0.001758	0.000000	0.000000	0.000000
ESE	0.001084	0.002100	0.001324	0.000000	0.000000	0.000000
SE	0.001201	0.002922	0.001667	0.000000	0.000000	0.000000
SSE	0.001146	0.002169	0.001553	0.000000	0.000000	0.000000
S	0.001965	0.004247	0.003562	0.000000	0.000000	0.000000
SSW	0.000940	0.002009	0.001758	0.000000	0.000000	0.000000
SW	0.001064	0.002329	0.002283	0.000000	0.000000	0.000000
W	0.001266	0.002648	0.001781	0.000000	0.000000	0.000000
WNW	0.001263	0.002443	0.001781	0.000000	0.000000	0.000000
NW	0.000770	0.001370	0.000662	0.000000	0.000000	0.000000
NNW	0.000708	0.001849	0.001050	0.000000	0.000000	0.000000
NW	0.000767	0.001530	0.000936	0.000000	0.000000	0.000000

Table 2.6-5 (Continued)

Joint Frequency Distribution of Wind Speed and Direction by Stability Class for Shreveport LCD Station (1984 to 1988)

Wind Sector	Wind Speed Category Midpoints at Anemometer Height (20 ft), m/s					
	1.5	2.5	4.3	6.8	9.5	12.5
			Stability Class C			
N	0.000511	0.003196	0.007671	0.000776	0.000000	0.000000
NNE	0.000261	0.001393	0.003151	0.000411	0.000000	0.000000
NE	0.000294	0.001735	0.003196	0.000411	0.000000	0.000000
ENE	0.000197	0.001256	0.002648	0.000274	0.000000	0.000000
E	0.000500	0.002306	0.005228	0.000297	0.000000	0.000000
ESE	0.000438	0.002443	0.004269	0.000457	0.000046	0.000000
SE	0.000689	0.002968	0.006256	0.000639	0.000000	0.000000
SSE	0.000586	0.002420	0.005411	0.000936	0.000000	0.000000
S	0.000866	0.005046	0.011530	0.002192	0.000068	0.000023
SSW	0.000434	0.002146	0.004498	0.000662	0.000000	0.000000
SW	0.000415	0.002717	0.004886	0.000639	0.000023	0.000000
W	0.000636	0.002671	0.004977	0.000616	0.000023	0.000000
WNW	0.000323	0.001781	0.003562	0.000639	0.000000	0.000000
NW	0.000211	0.001142	0.002443	0.000342	0.000046	0.000000
NNW	0.000211	0.001393	0.003516	0.000616	0.000023	0.000000
NW	0.000208	0.001370	0.003744	0.000502	0.000000	0.000000
			Stability Class D			
N	0.001621	0.007900	0.018562	0.012648	0.001210	0.000023
NNE	0.000917	0.005205	0.011621	0.004452	0.000342	0.000023
NE	0.000750	0.003973	0.009018	0.003356	0.000023	0.000000
ENE	0.000820	0.004452	0.009429	0.002968	0.000046	0.000000
E	0.001259	0.006712	0.010548	0.002717	0.000091	0.000000
ESE	0.001319	0.007877	0.008196	0.001849	0.000091	0.000046
SE	0.002324	0.010320	0.017123	0.006233	0.000274	0.000023
SSE	0.001594	0.007352	0.020046	0.009292	0.000708	0.000137
S	0.001871	0.010548	0.030365	0.024612	0.001735	0.000114
SSW	0.000607	0.003516	0.008744	0.004817	0.000320	0.000000
SW	0.000770	0.003653	0.006301	0.004110	0.000137	0.000000
W	0.000661	0.002763	0.003653	0.002854	0.000320	0.000091
WNW	0.000398	0.002626	0.003858	0.004110	0.000571	0.000068
NW	0.000475	0.002123	0.005662	0.005388	0.000571	0.000365
NNW	0.000587	0.003037	0.008219	0.011119	0.001575	0.000183
NW	0.000512	0.002511	0.007100	0.008014	0.000776	0.000091

Table 2.6-5 (Continued)

Joint Frequency Distribution of Wind Speed and Direction by Stability Class for Shreveport LCD Station (1984 to 1988)

Wind Sector	Wind Speed Category Midpoints at Anemometer Height (20 ft), m/s 1.5	2.5	4.3	6.8	9.5	12.5
			Stability Class E			
N	0.000000	0.003630	0.006416	0.000000	0.000000	0.000000
NNE	0.000000	0.002397	0.003174	0.000000	0.000000	0.000000
NE	0.000000	0.001941	0.002443	0.000000	0.000000	0.000000
ENE	0.000000	0.002032	0.003470	0.000000	0.000000	0.000000
E	0.000000	0.004863	0.003014	0.000000	0.000000	0.000000
ESE	0.000000	0.005708	0.001644	0.000000	0.000000	0.000000
SE	0.000000	0.009178	0.002945	0.000000	0.000000	0.000000
SSE	0.000000	0.007489	0.004840	0.000000	0.000000	0.000000
S	0.000000	0.010571	0.012123	0.000000	0.000000	0.000000
SSW	0.000000	0.003219	0.003973	0.000000	0.000000	0.000000
SW	0.000000	0.002945	0.002100	0.000000	0.000000	0.000000
W	0.000000	0.002763	0.001416	0.000000	0.000000	0.000000
WNW	0.000000	0.0027[illegible]5	0.002237	0.000000	0.000000	0.000000
NW	0.000000	0.001644	0.004406	0.000000	0.000000	0.000000
NNW	0.000000	0.001712	0.005548	0.000000	0.000000	0.000000
NW	0.000000	0.001164	0.003425	0.000000	0.000000	0.000000
			Stability Class F			
N	0.005055	0.006735	0.000000	0.000000	0.000000	0.000000
NNE	0.003185	0.004338	0.000000	0.000000	0.000000	0.000000
NE	0.002561	0.002123	0.000000	0.000000	0.000000	0.000000
ENE	0.002452	0.003470	0.000000	0.000000	0.000000	0.000000
E	0.005227	0.005753	0.000000	0.000000	0.000000	0.000000
ESE	0.012060	0.006963	0.000000	0.000000	0.000000	0.000000
SE	0.018176	0.008995	0.000000	0.000000	0.000000	0.000000
SSE	0.016851	0.008950	0.000000	0.000000	0.000000	0.000000
S	0.016726	0.017854	0.000000	0.000000	0.000000	0.000000
SSW	0.007206	0.007100	0.000000	0.000000	0.000000	0.000000
SW	0.005938	0.005000	0.000000	0.000000	0.000000	0.000000
W	0.016209	0.006781	0.000000	0.000000	0.000000	0.000000
WNW	0.020[illegible]4	0.009018	0.000000	0.000000	0.000000	0.000000
NW	0.0074[illegible]6	0.006096	0.000000	0.000000	0.000000	0.000000
NNW	0.002597	0.004977	0.000000	0.000000	0.000000	0.000000
NW	0.001744	0.001941	0.000000	0.000000	0.000000	0.000000

Table 2.6-6

F-Scale Classification of Tornados
Based on Appearance of Damage[a]

(F0) LIGHT DAMAGE -- 40-72 mph

This speed range corresponds to Beaufort 9 through 11. Some damage chimneys of TV antennae occurs; branches broken off trees; shallow-rooted trees pushed over; old trees with hollow insides break or fall; sign boards are damaged.

(F1) MODERATE DAMAGE -- 73-112 mph

73 mph is the beginning of hurricane wind speed of Beaufort 12. Surfaces of roofs peeled off; windows broken; trailer houses are pushed or overturned; trees on soft ground are uprooted; some trees snapped; moving autos pushed off road.

(F2) CONSIDERABLE DAMAGE -- 113-157 mph

Roofs torn off of frame houses, leaving strong upright walls standing; weak structures or outbuildings are demolished; trailer houses are demolished; railroad boxcars are pushed over; large trees snapped or uprooted; light-object missiles generated; cars blown off highway; block structures and wall badly damagrd.

(F3) SEVERE DAMAGE -- 158-206 mph

Roofs and some walls torn off well-constructed frame houses; some rural buildings completely demoished or flattened; trains overturned; steel frame hangar-warehouse type structures torn; cars lifted off the ground and may roll some distance; most trees in a forest uprooted, snapped or leveld; block structures often leveled.

(F4) DEVASTATING DAMAGE -- 207-260 mph
Well-constructed frame houses leveled, leaving piles of debris; structures with weak foundations lifted, torn, and blown off some distance; trees debarked by small flying debris; sandy soil eroded and gravel flies in high winds; cars thrown some distance or rolled considerable distance, finally to disintegrate; large missiles generated.

(F5) INCREDIBLE DAMAGE -- 261-318 mph

Strong frame houses lifted clear off foundation and carried considerable distance to disintegrate; steel-reinforced concrete structures badly damaged; automobile-sized missiles fly distances of 100 yards or more; trees debarked completely; incredible phenomena can occur.

[a](Reference 12)

Table 2.6-7

Descriptions of Violent Tornados (F-Scale Classification 4 & 5)
That Have Occurred in the Vicinity of the CEC Site
During the Period 1880-1982 (a)

Number (b)	Date	Time	Path Length	Path Width	Dead	Injured	Class	Description
199	May 13, 1908	1730	25 mi	600 yd	49	150	F4	From SE of Oil City, Caddo Parish, this tornado moved to the NE and struck two towns, Gilliam, Caddo Parish and Bolinger, Bossier Parish. 40 of the 49 deaths occurred at Gilliam, as dozens of small homes were leveled. Only 2 homes in the town remained upright, but most of those leveled were of poor construction.
434	March 30, 1933	1630	20 mi	500 yd	7	40	F4	The funnel first touched down just N of Hall Summit, Red River Parish, and moved E and ENE across Bienville Parish. 5 miles NE of Hall Summit a small house was completely swept away, and 5 people were killed. Many other buildings were leveled along the path, which ended W of Jonesboro, Jackson Parish. Damage totalled about $60,000.
437	May 1, 1933	1600	6 mi	800 yd	23	400	F4	This rather short path tornado was very large and intense. Touching down 4 miles WSW of Minden, Webster Parish, the tornado moved NNE through that town, virtually leveling it. 500 homes were damaged to some degree, and property damage was estimated at $1,250,000. Scores of homes were leveled, and many were swept completely away.

Table 2.6-7 (Continued)

Number	Date	Time	Path Length	Path Width	Dead	Injured	Class	Description
438	May 1, 1933	1700	5 mi	800 yd	6	50	F4	As with the previous event, this tornado was on the ground only a short time but was very large. Touching down WSW of Arcadia, the tornado moved to the NE and passed along the N edge of Arcadia. Moving from Bienville to Claiborne Parish, the funnel dissipated. 60 homes were destroyed, with most of them being leveled. 98 other homes were damaged, and the total loss was $200,000. A mile further to the SE, and Arcadia would likely have resembled Minden, in the previous event.
477	April 16, 1939	1355	5 mi	200 yd	8	37	F4	This tornado touched down SW of Haynesville, Webster Parish, and moved along the edge of town, destroying 37 homes. People died in a few small houses which were completely swept away. Damage totalled $75,000.
566	December 31, 1947	1600	60 mi	400 yd	18	220	F4	Touching down 10 miles N of Shreveport, this tornado moved to the NE and ENE across Bossier, Webster, and Claiborne Parishes before dissipating S of El Dorado, Arkansas. Homes were leveled in many small communities, but the worst hit was Cotton Valley, Webster Parish, where 14 of the deaths occurred and most of the $1,500,000 damage was done. 2/3 of the buildings in Cotton Valley were damaged or destroyed. 2 people died near Haynesville, where 20 injuries and $450,000 in damage occurred. Other deaths were at Lake Leton and Dykesville.

TABLE 2.6-7(Continued)

Number	Date	Time	Path Length	Path Width	Dead	Injured	Class	Description
601	February 12, 1950	1100	103 mi	400 yd	23	100	F4	Touchdown occurred 3 miles SE of Center, Shelby Co. and moved NE, crossing into Louisiana near Logansport, Desoto Parish. Continuing to the NE the tornado passed SE and E of Shreveport, passing out of Louisiana and into Arkansas about 7 miles NW of Haynesville. The weak funnel skipped across Columbia Co. and lifted near Mt. Holly. One of many strong tornadoes in this area on this day, people were killed at various points along the path in Louisiana. 3 deaths occurred near Haslam, Texas across the river from Logansport. Saw mills and frame houses were leveled all along the path, with $250,000 damage at Slack AF" near Shreveport. 6 airmen died an.. .5 were injured as the AFB depot was destroyed. 8 people died in Desoto Parish, near Grand Cane. 4 peopled died near Sligo, Bossier Parish, and 2 people died in the Hood's Quarter area on the edge of Shreveport The path was not continuous.
945	December 3, 1978	0150	8 mi	400 yd	2	266	F4	This tornado touched down just across the Red River from Veteran's park, after which it moved to the NE, passing through the city of Bossier City, Bossier Co. Schools, homes, business and apartments were devastated. 75 homes and 51 businesses were listed as destroyed, but hundreds of others were badly damaged. Estimates of losses ran from $25,000,000 to $100,000,000.

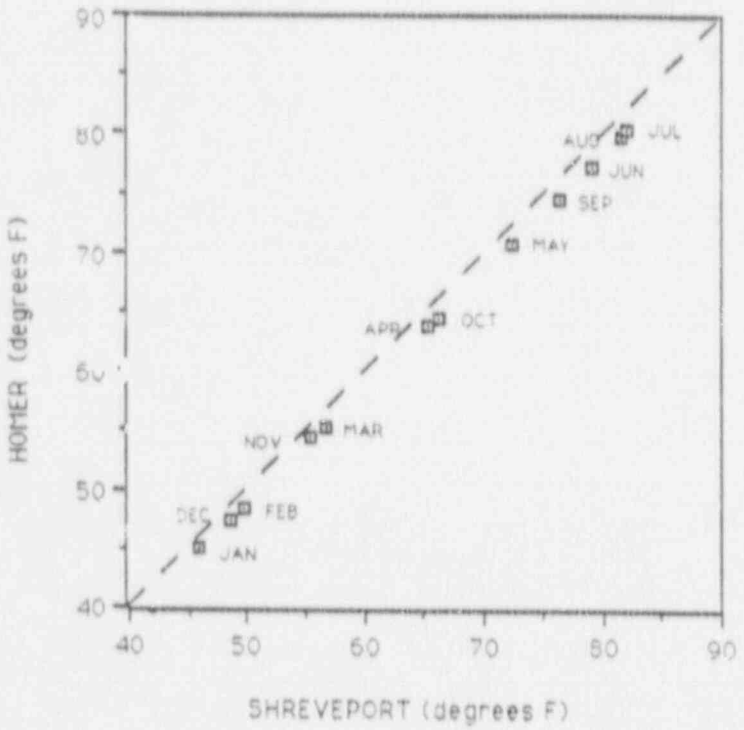
(a) Information taken directly from: Grazulis (1984).
(b) Refer to Figure 2.6-12 (also from Grazulis 1984) for the path numbers of these tornados.

TABLE 2.6.8

NATIONAL AMBIENT AIR QUALITY STANDARDS (KAAQS)

Pollutant	Standard (ug/m3)	Averaging Time
PM-10 (a)	150	24-hour
	50	Annual
Sulfur Dioxide	1,300	3-hour
	365	24-hour
	80	Annual
Ozone	235 (0.12 ppm)	1-hour
Lead	1.5	3-months
Nitrogen Dioxide	100	Annual

(a) Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.

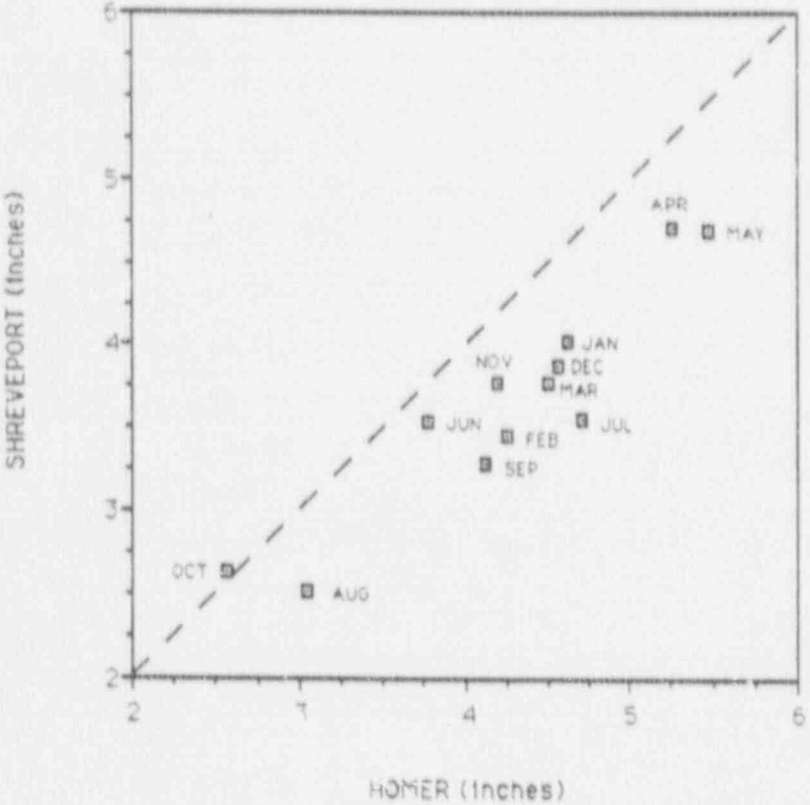


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Comparison of Monthly Average Temperatures in Shreveport and Homer, Louisiana (1951 to 1980)

Figure 2.6-1

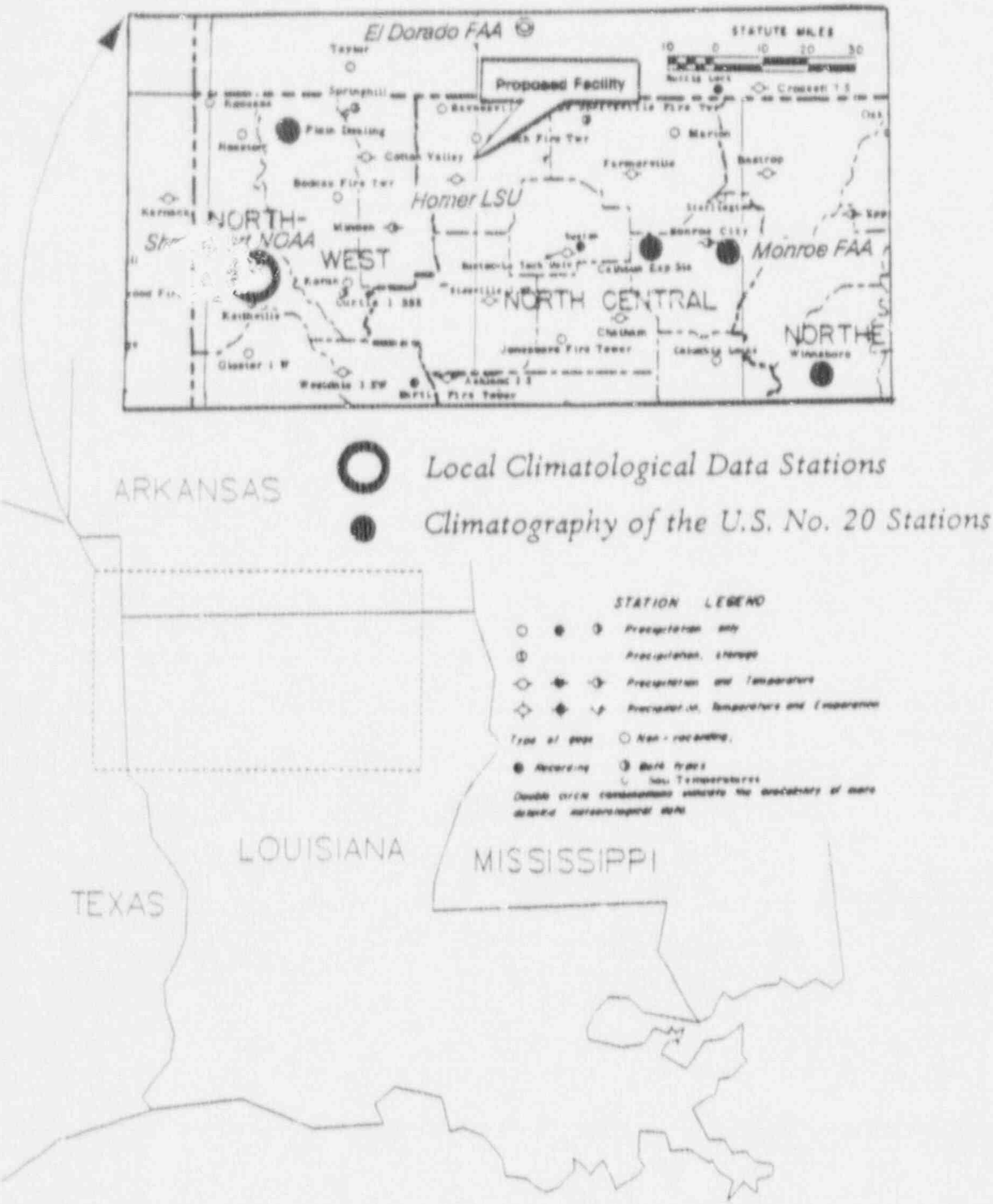


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Comparison of Monthly Average Precipitation in Shreveport and Homer, Louisiana (1951 to 1980)

Figure 2.6-2

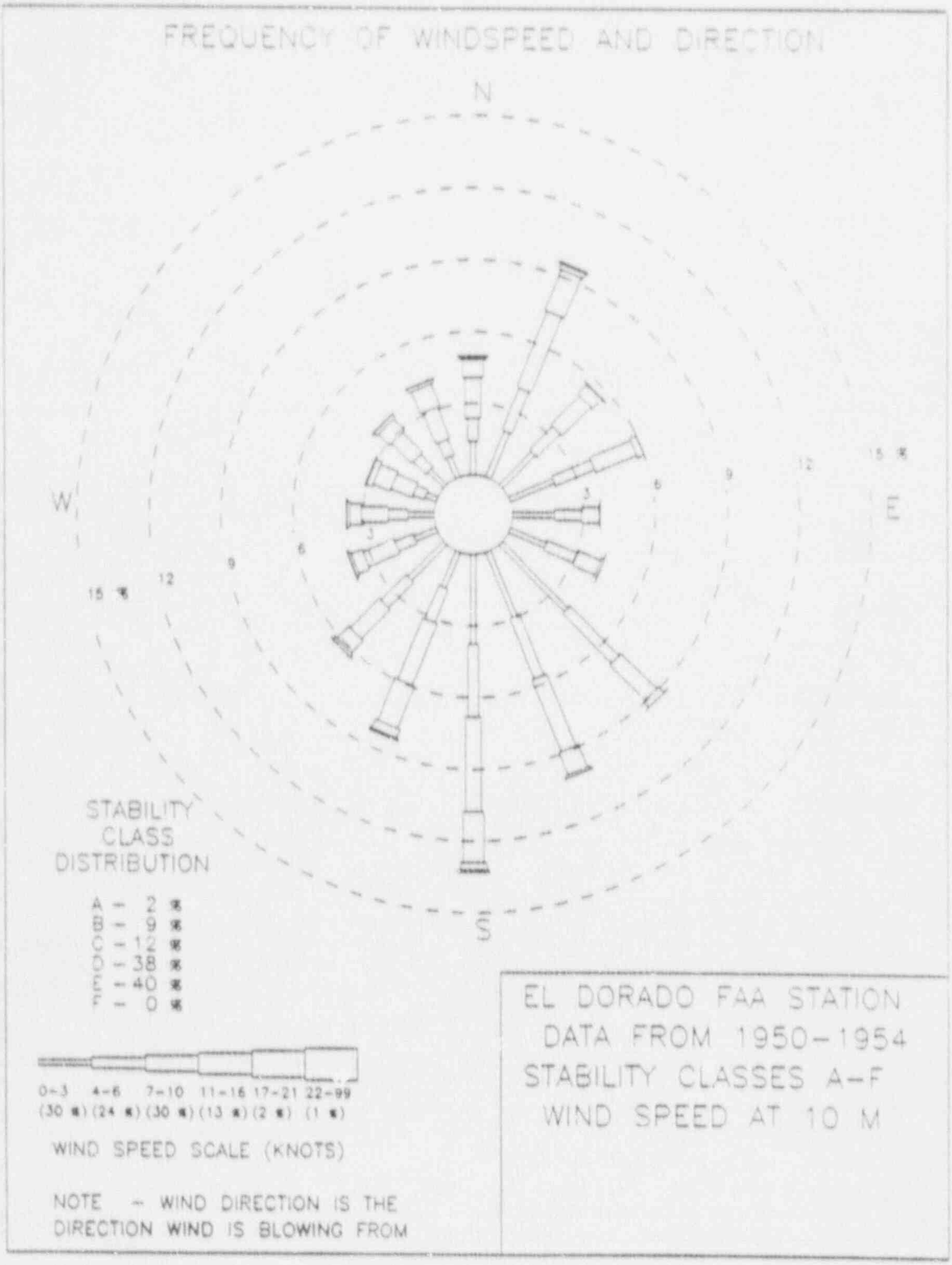


(Reference 5)

CLAIBORNE ENRICHMENT CENTER

Location of Stations Used in Meteorological Characterization

Figure 2.6-3

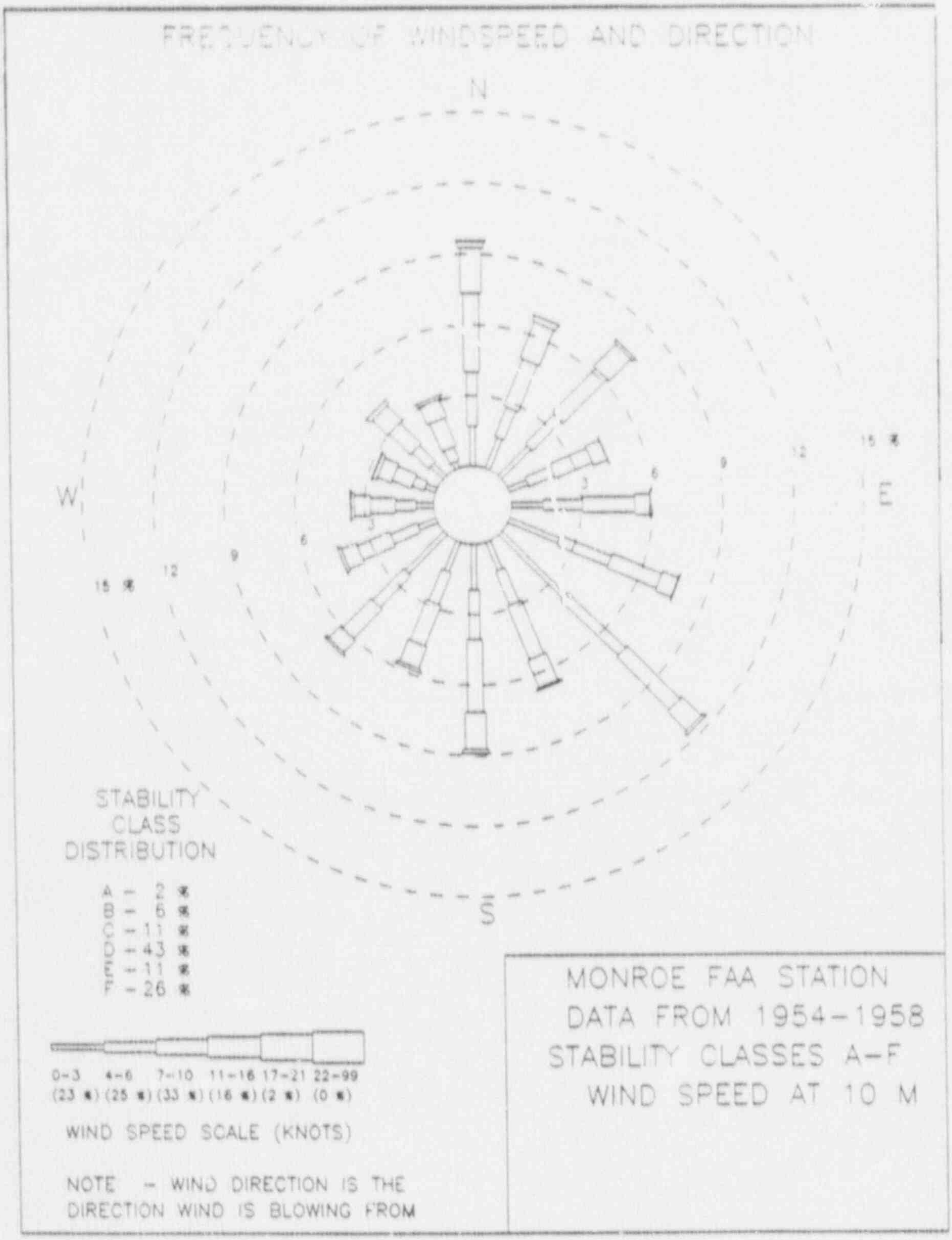


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Frequency of Wind Speed and Direction (El Dorado 1950–1954)

Figure 2.6–4



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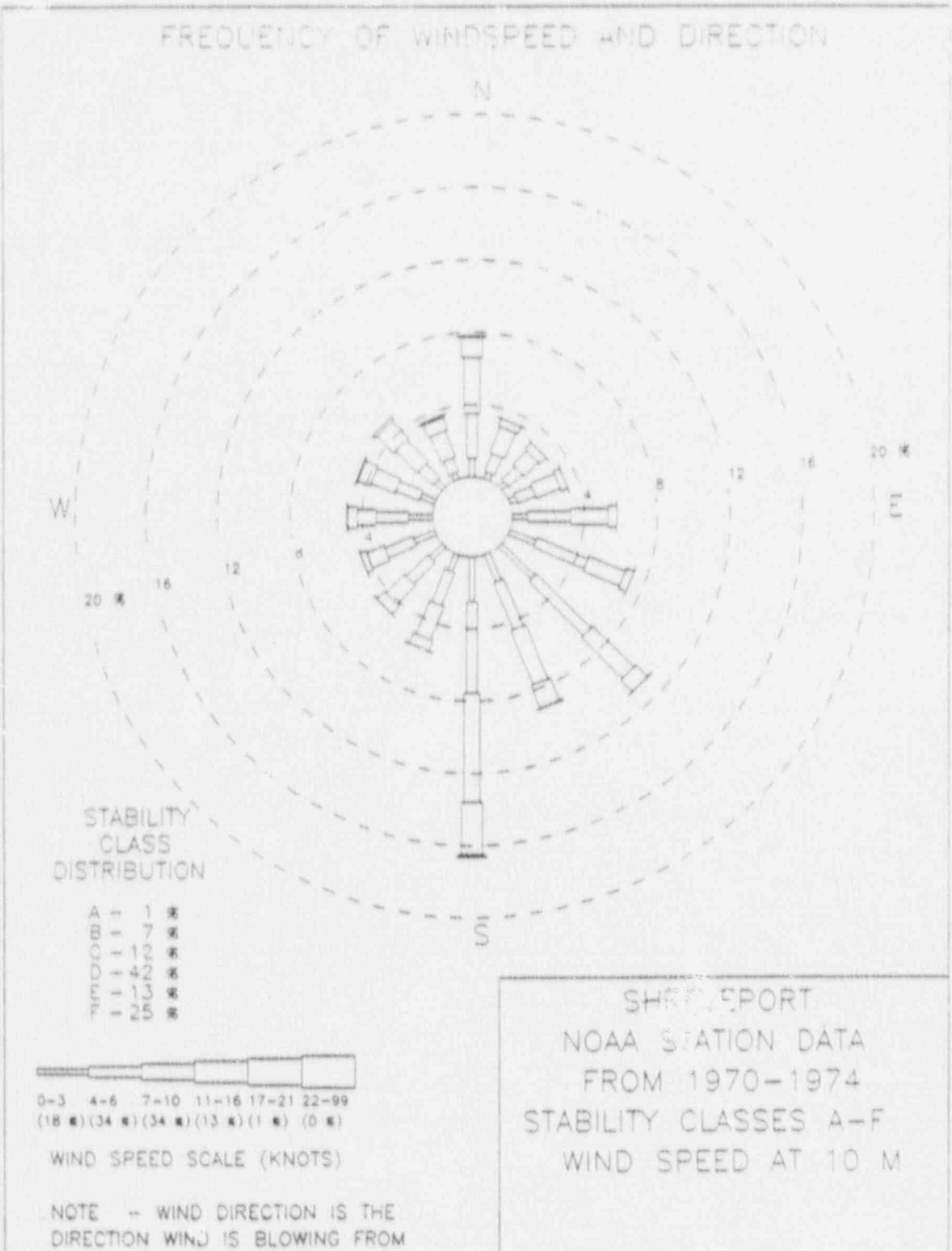
Frequency of Wind Speed and Direction (Monroe 1954-1958)

Figure 2.6-5



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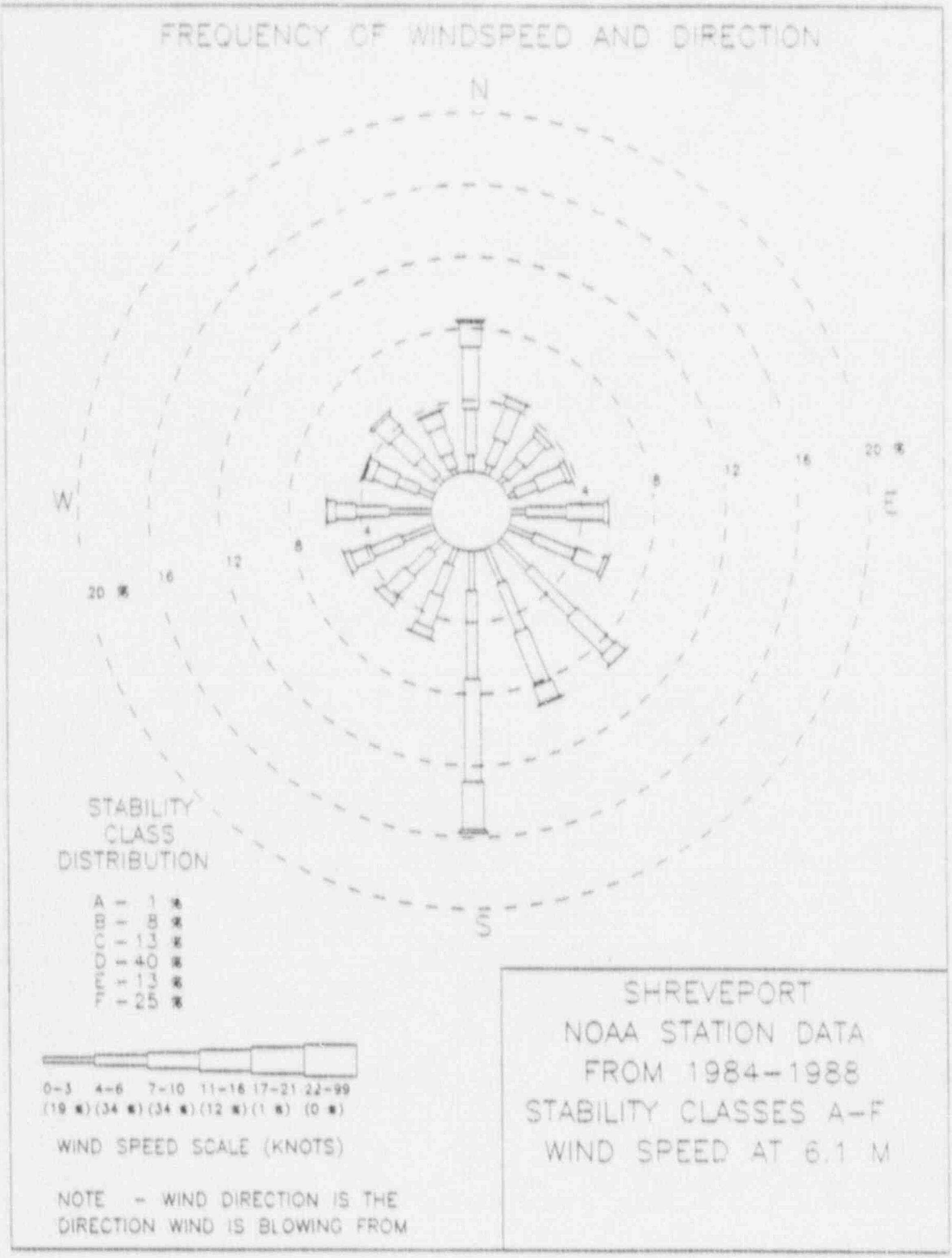
Frequency of Wind Speed and Direction Shreveport (1970–1974)

Figure 2.6-6



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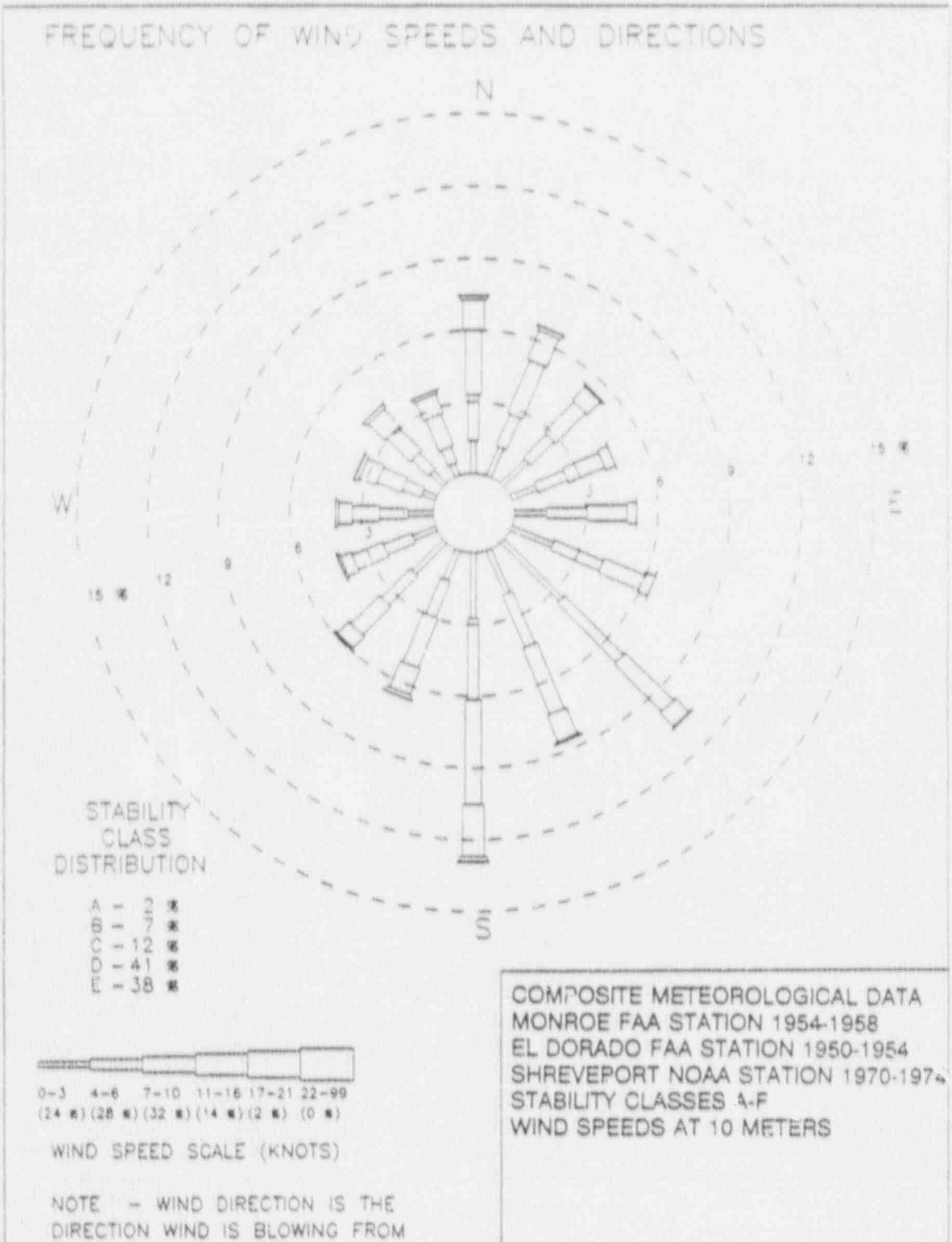
Frequency of Wind Speed and Direction Shreveport (1984-1988)

Figure 2.6-7



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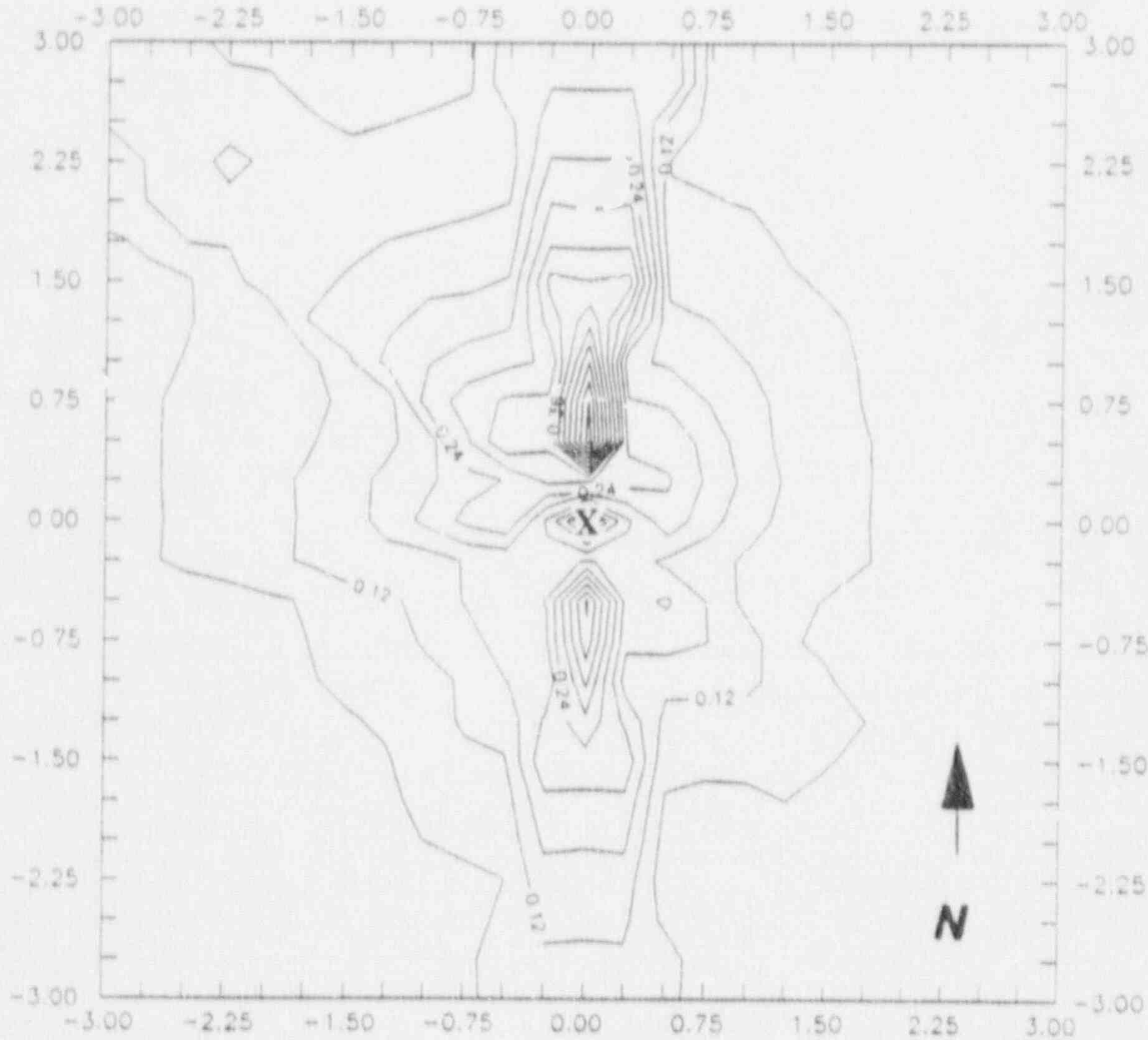
Frequency of Wind Speeds and Directions (Composite)

Figure 2.6-8



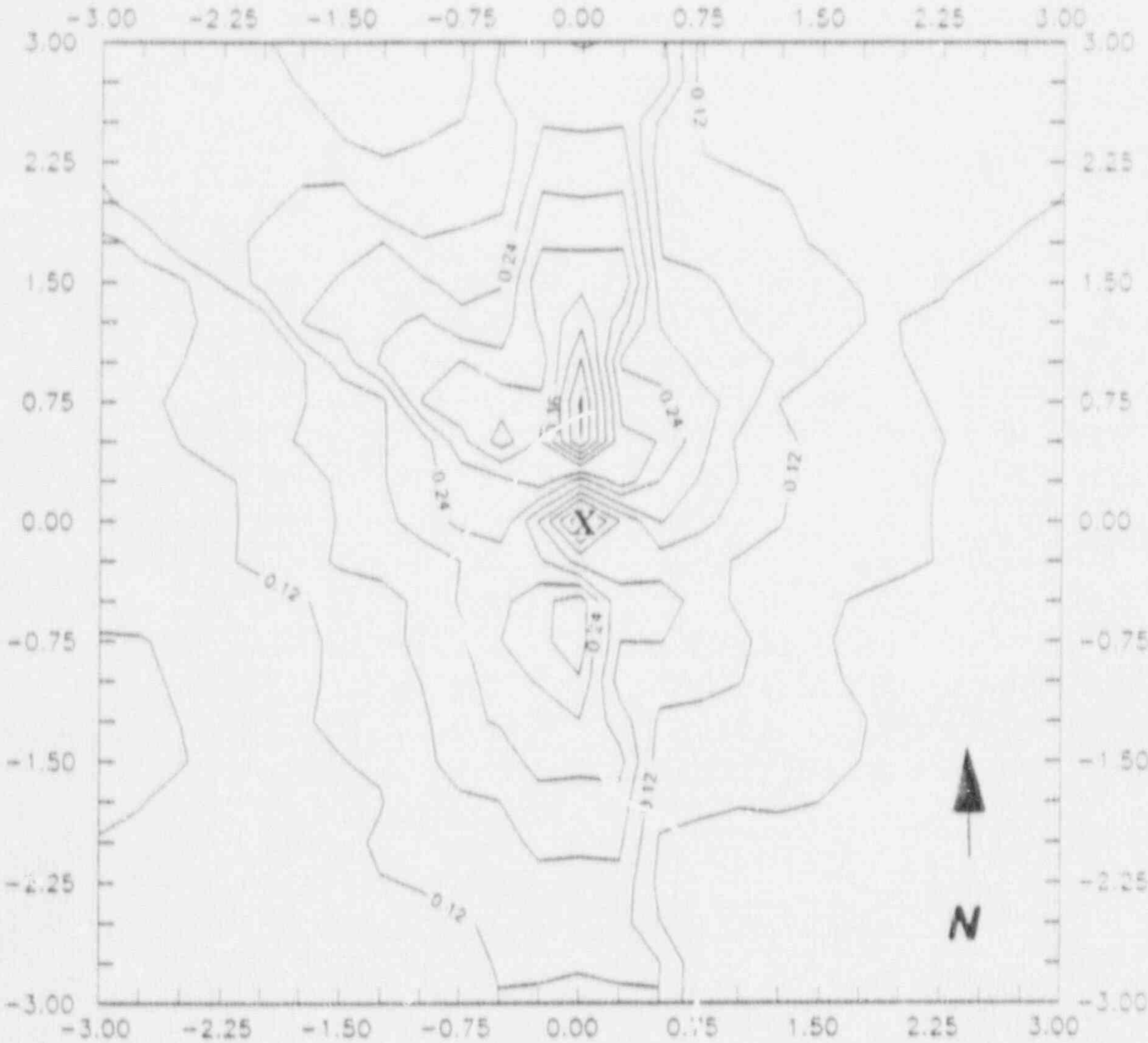
* χ/Q values in $\mu g/m^3$ per g/sec
* Scale in kilometers

X Stack Location

CLAIBORNE ENRICHMENT CENTER

ISCLT Modeled Results of Ground Level x/Q (Shreveport Data)

Figure 2.6-9



* χ/Q values in $\mu g/m^3$ per g/sec
* Scale in kilometers

X Stack Location

LOUISIANA ENERGY

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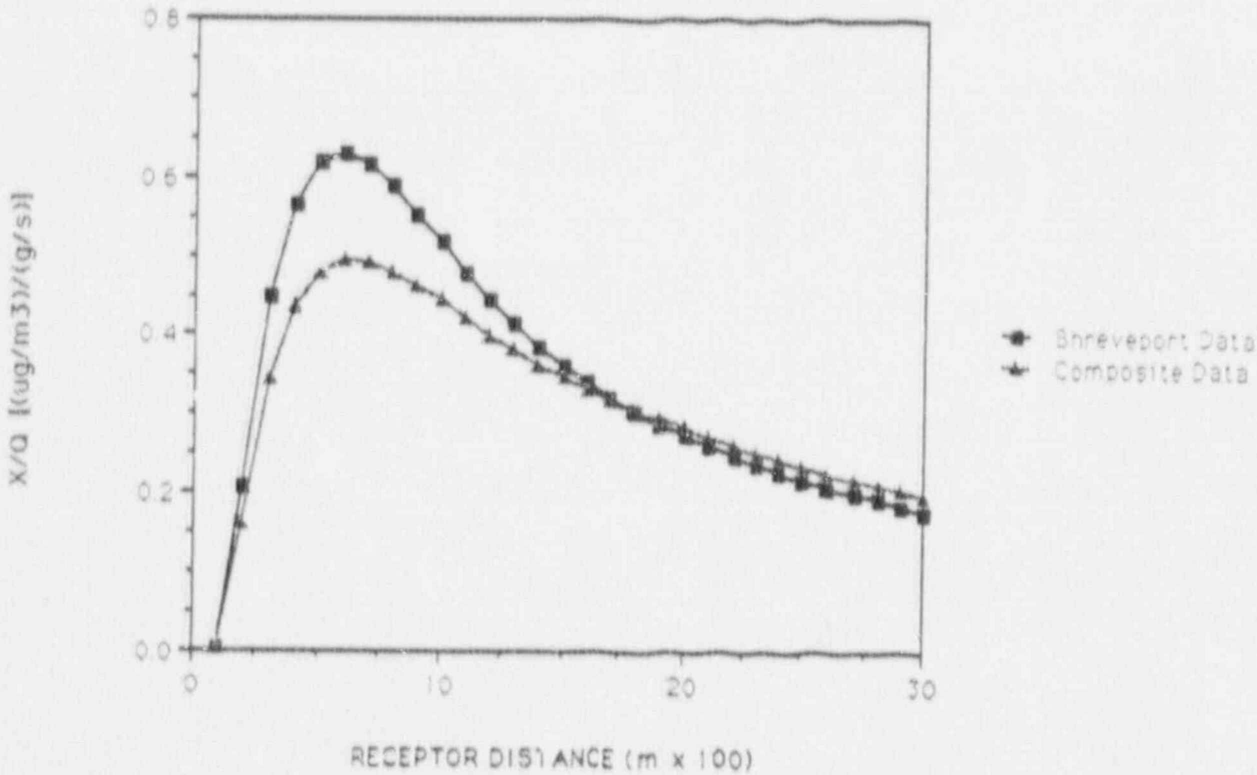
ICSLT Modeled Results of Ground Level χ/Q (Composite Data)

Figure 2.6-10



a) Composite data based on meteorological data from Shreveport NOAA Station (1970 to 1974), Monroe FAA Station (1954 to 1958) and El Dorado FAA Station (1950 to 1954)

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Comparison of ISCLT Model Results x/Q – North Azimuth (Shreveport and Composite)

Figure 2.6–11

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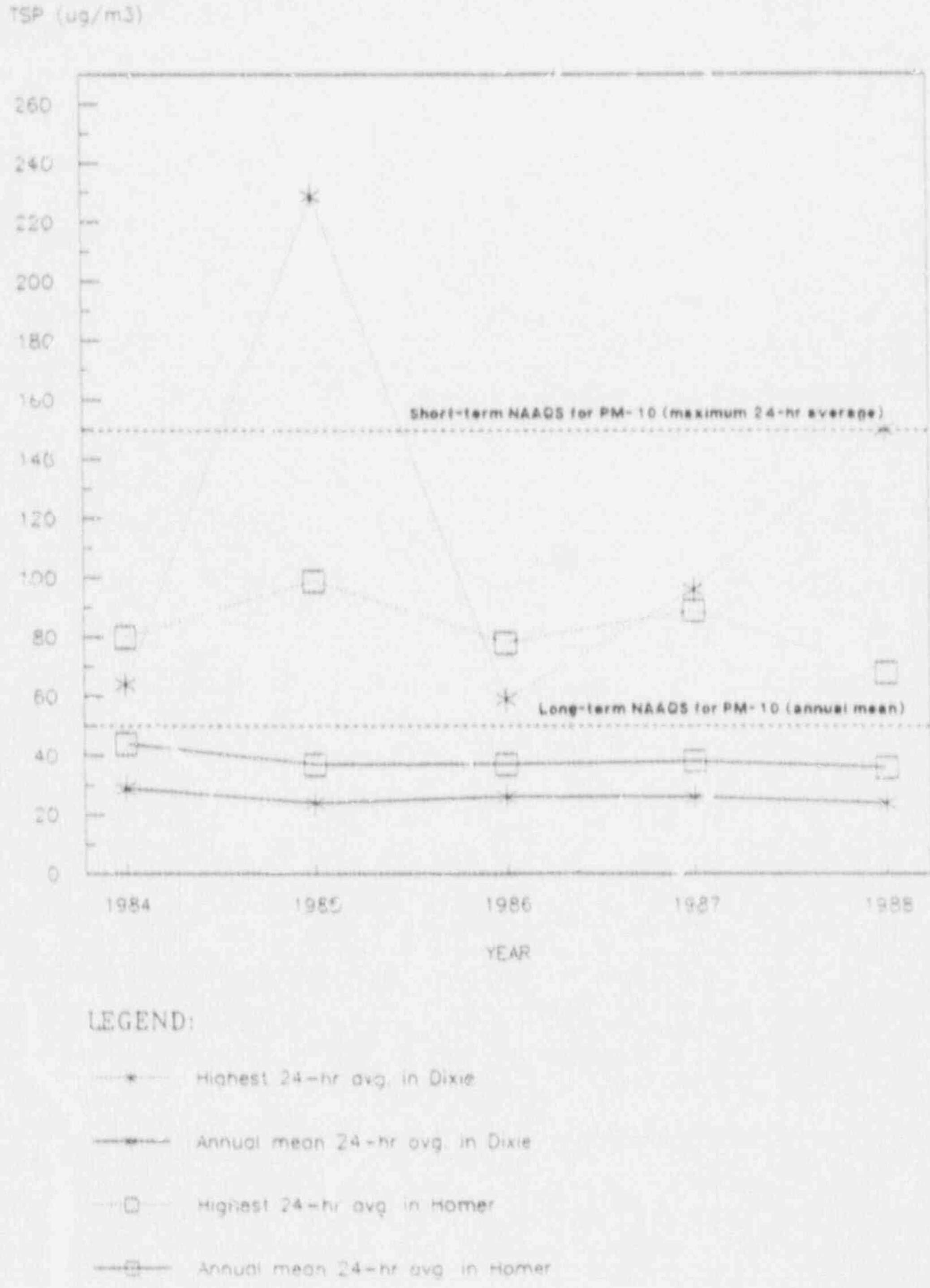
Paths of F4 and F5
Class Tornados in Louisiana
From 1880 to 1982

Figure 2.6-12



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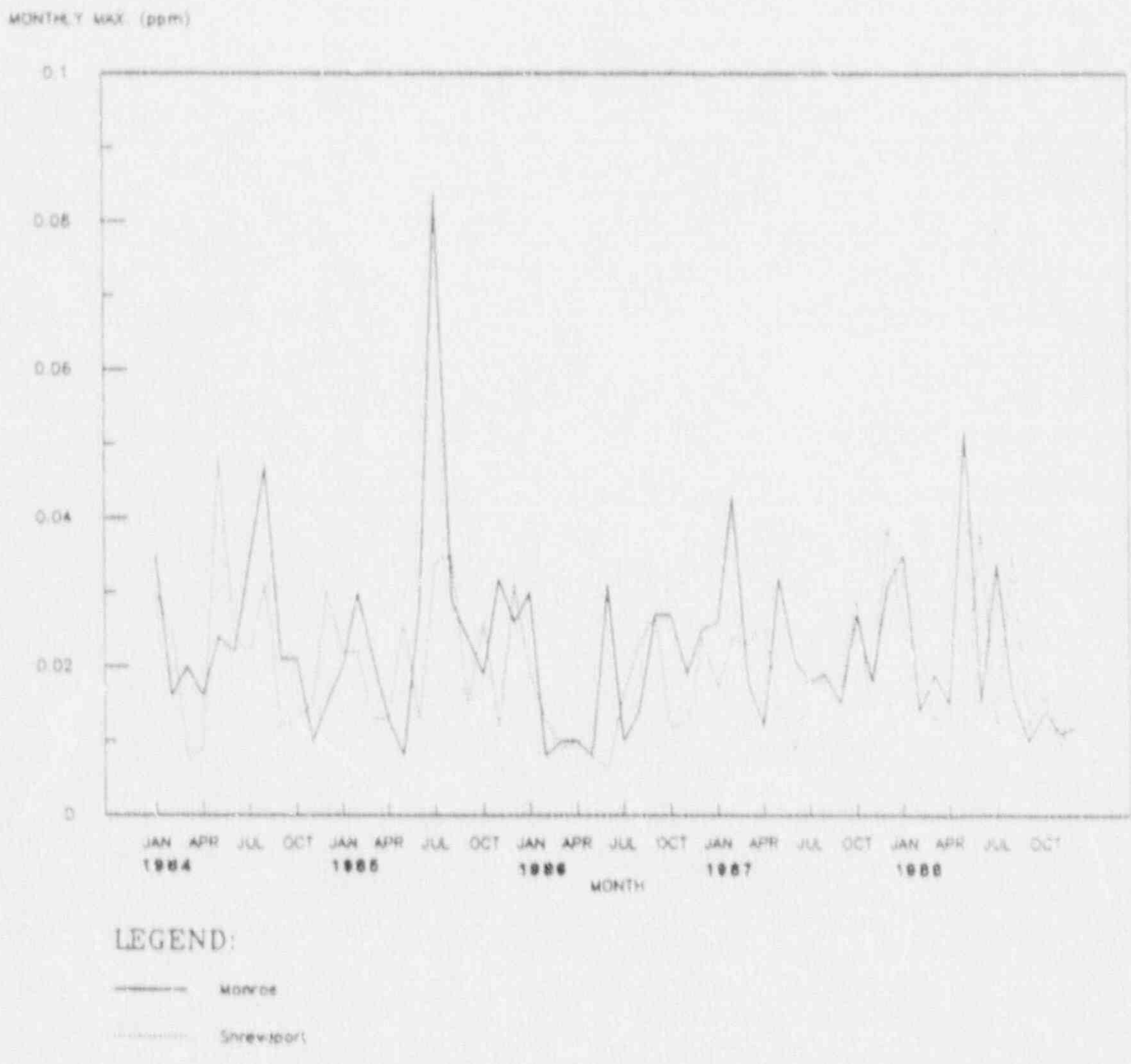
Total Suspended Particulate (TSP) Observations in Northeastern Louisiana

Figure 2.6-13



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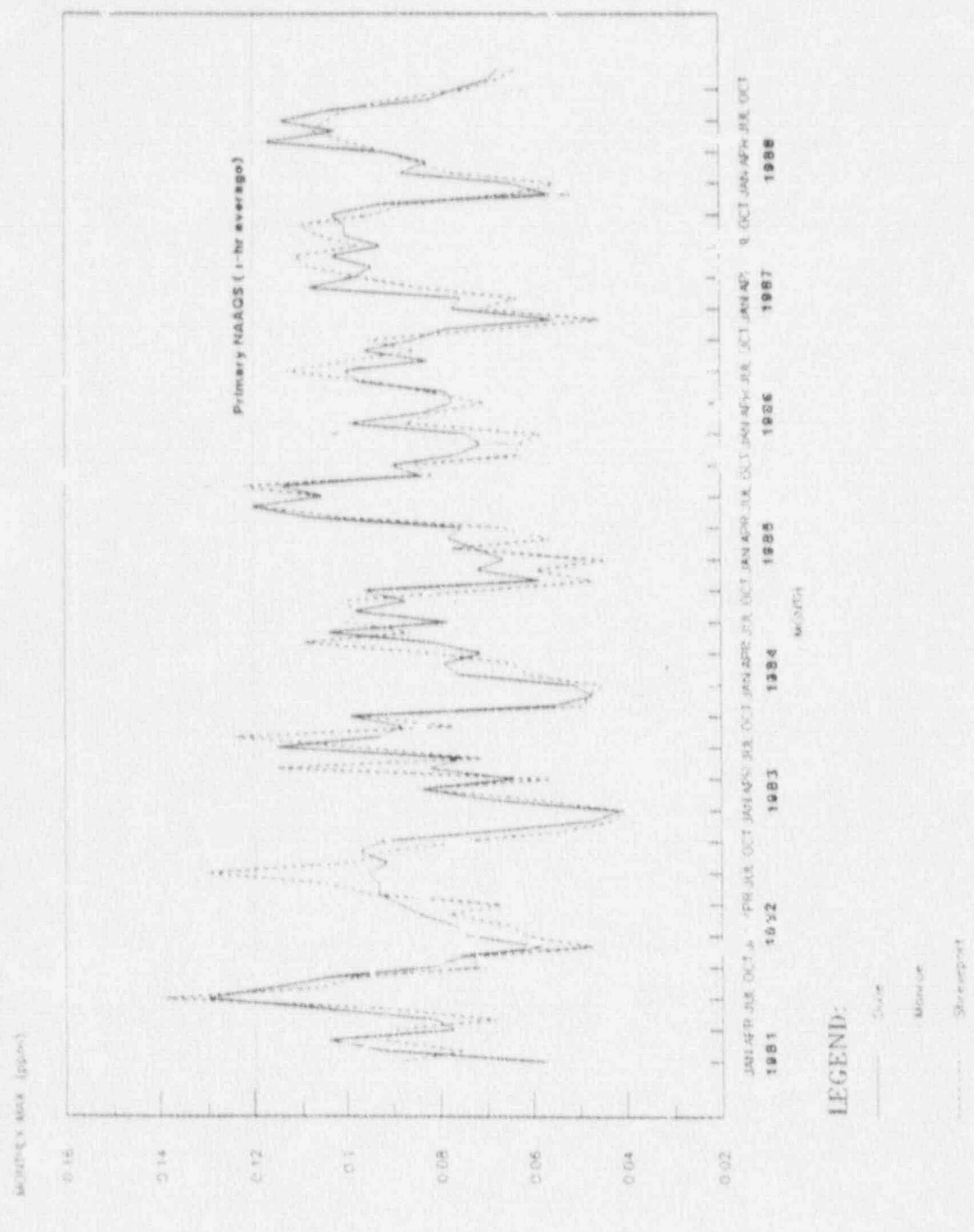
Monthly Maximum 1-hr Average Sulfur Dioxide Concentrations in Northern Louisiana

Figure 2.6-14



LOUISIANA ENERGY

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Monthly Maximum 1-hr Average Ozone Concentrations for Select Stations in Northern Louisiana

Figure 2.6-15

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2.7 ECOLOGY

This section describes the terrestrial and aquatic communities of the CEC site. This section is intended to provide a baseline characterization of the site's ecology prior to any disturbances associated with construction or operation of the LES facility. Prior environmental disturbances (e.g., timbering) not associated with the facility and their effect on the site ecology are considered when describing the baseline condition. The baseline conditions described are those that existed at the LES site after the extensive clearcutting, which occurred in the spring and early summer of 1990.

For each major community at the CEC site, the plant and animal species that comprise that community are identified and their distribution and relative abundance are discussed. Based on this initial inventory of species, those species that are regarded as important are identified. As defined in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 4.9 (Reference 1), important species are those for which a specific causal link can be identified between the enrichment facility and the species, and for which one or more of the following criteria apply:

1) the species is commercially or recreationally valuable;
2) the species is threatened or endangered (as defined in the Endangered Species Act of 1973, as amended [P.L. 93-205]);
3) the species affects the well-being of some important species within criteria 1 or 2; or
4) the species is critical to the structure and function of the ecological system or is a biological indicator of radionuclides in the environment (Reference 1).

Once important species have been identified, their interrelationship with the environment (functional ecology) is described. To the extent possible, these descriptions include discussions of the species' habitat requirements, life history, and population dynamics. Also, as part of the evaluation of important species at the site, preexisting environmental stresses which may have impacted the ecological integrity of the site and affected important species are identified.

The discussion of the terrestrial and aquatic communities at the LES site is divided into three major sections: 2.7.1 discusses the terrestrial plant communities at the site; 2.7.2 discusses the terrestrial wildlife communities at the site; and, 2.7.3 discusses the aquatic communities at the site.

2.7.1 TERRESTRIAL ECOLOGY: PLANT COMMUNITIES

The LES site lies in the Lower Loam Hills Region of the Hilly Coastal Plain Physiographic Province (Reference 2). This Region was at one time covered primarily by mixed pine and hardwood forests. However, forestry and agricultural practices have changed the vegetative communities of the Region. Currently, pines (primarily loblolly [Pinus taeda] and short leaf [Pinus palustris] pine) are the dominant species on most forested upland sites within the Region, although some areas still reflect the mixed pine-hardwood forest structure characteristic of the original plant communities in the Region. Alluvial forests dominated by mixed hardwood species occur in the bottomlands along the many small drainage ways and streams that dissect the Region.

2.7.1.1 Plant Communities at the LES Site

The plant communities at the LES site generally reflect the range of plant communities within the Lower Loam Hills Region of Louisiana. As part of the botanical investigation conducted on the CEC site property in June 1990, five distinct plant communities were identified. These are (listed in order of their prevalence at the CEC site):

1) upland mixed forest--recent harvest
2) upland mixed forest--several years since harvest
3) upland forest--pine dominated
4) upland mixed forest--mature
5) bottomland hardwood forest

A map of the terrestrial plant communities at the site is presented in Figure 2.7-1. Each of these communities is described below with respect to its distribution and prevalence at the site and species composition. The relative abundance of the different plant species within each community also is noted. The following qualitative terms are used to describe the relative abundance of plant species on the site:

Dominant: the most prevalent species within a given vegetative community based on considerations of biomass (qualitatively determined by number and size of individuals). A community may have one or more dominant species or no dominant species.

Common: a species that has a high probability of being noted at any random point within a specific vegetative community.

Moderate: a species that may or may not be in view at any random point but that may be located with a limited amount of searching.

Scattered: a species that occurs only a few times within a given vegetative community or a species that is abundant in only one or two localized areas.

The following discussion of the plant communities at the LES site is based primarily on the site-specific survey conducted.

2.7.1.1.1 Upland Mixed Forest--Recent Harvest

Recently harvested upland mixed forest is the dominant vegetative community on the CEC site, occupying approximately 61% or 271 acres of the total land area of the LES site. Most of this area was clearcut during late winter through early summer in 1990. As can be seen from Figure 2.7-1, the majority of the recently harvested area lies west of Parish Road 39, dominating the entire western half of the LES property. The remaining portion lies east of Lake Avalyn.

A considerable amount of slash covers the area through which numerous species of herbaceous plants occur. Many of these species are invaders such as panic grass (Dichanthelium sp.), dogfennel (Eupatorium capillifolium), fireweed (Erechtites hieracifolia), partridge pea (Cassia sp.), tick trefoil (Desmodium sp.), dewberry and blackberry (Rubus sp.), grape (Vitis sp.), doveweed (Croton capitatus), and lespedezea (Lespedezea sp.).

Young woody plants also occur in the recently clearcut area. Among these are sassafras (Sassafras albidum), sweetgum (Liquidambar styraciflua), winged sumac (Rhus copallina), persimmon (Diospyros virginiana), and loblolly pine. In addition, several species of oaks (Quercus spp.), white ash (Fraxinus americana), red maple (Acer rubrum), and other woody species have developed sprouts from existing root systems. There are also some scattered woody species left uncut, primarily saplings such as sweetgum, red maple and black gum (Nyssa sylvatica).

Table 2.7-1 lists the plant species present in the recently harvested upland mixed forest at the site. The relative abundance of each species also is noted.

2.7.1.1.2 Upland Mixed Forest--Several Years Since Harvest

Previously harvested upland mixed forest occupies approximately 17% or 75 acres of the total land area of the LES property. As can be seen from Figure 2.7-1, all of the formerly harvested upland mixed forest lies east of Parish Road 39 and occurs primarily south and east of Lake Avalyn. Most of this area probably was harvested around 1980 or earlier, but some may have been harvested as recently as 1985. Vegetation in the older cut areas is dominated by sweetgum and loblolly pine. Vegetation in the younger cut areas is dense and comprised of a variety of woody and herbaceous species. A few small logging roads and small clearings also exist in the area. The plant communities associated with these areas differ slightly from those in the forested areas.

Table 2.7-2 lists the plant species present in the formerly harvested upland mixed forest at the site and along the roadsides and in clearings of this area. The relative abundance of each species also is noted.

2.7.1.1.3 Upland Forest--Pine Dominated

Pine-dominated upland forest occupies approximately 16% or 70 acres of the total land area of the LES property. The pine-dominated upland forest occurs east of Parish Road 39 and west and north of Lake Avalyn (see Figure 2.7-1). Loblolly pine is the dominant species in this area. The hardwood species present in the mixed upland forests of the site also occur here, but in much smaller numbers. There are several small clearings within the pine-dominated forests that are dominated by herbaceous plants.

Table 2.7-3 lists the plant species present in the upland pine forest at the site and their abundance.

2.7.1.1.4 Upland Mixed Forest--Mature

Mature upland mixed forest occupies approximately 4% or 18 acres of the total land area of the site. It is not known if this area is to be timbered in the near future. This thin strip of forest occurs near the western border of the CEC site (see Figure 2.7-1) and represents the most mature stand of timber on the CEC site. Loblolly pine, southern red oak (Quercus falcata), and red maple dominate the overstory, with white oak (Quercus alba), black gum, and water oak (Quercus nigra) also occurring frequently. The understory of this forest is much sparser than in the mixed forests that were harvested within the last 10 years (discussed above).

Table 2.7-4 lists the plant species present in the mature mixed upland forest at the LES property and their abundance.

2.7.1.1.5 Bottomland Hardwood Forest

Bottomland hardwood forests are the least prevalent plant community on the site, occupying approximately 2% or 9 acres of the total site area. These forests are limited primarily to small areas adjacent to Lake Avalyn and the small on-site pond. Narrow bands of bottomland hardwoods also line the larger drainages at the site but were not mapped given their relatively small size compared to the those bottomland areas near Lake Avalyn and the small pond.

Bottomland hardwood forests include all forested areas subject to inundation by floodwater for up to three months each year. Consequently, plant species that are adaptable to wet environments predominate the plant community. Common trees of the bottomland forest at the site are red maple, sweetgum, blackgum, common alder (Alnus serrulata), and blue beech (Carpinus caroliniana). Common herbaceous species include partridge berry, lady fern (Athyrium filix-femina), false nettle (Boehmeria cylindrica), and poison ivy (Rhus toxicodendron).

Table 2.7-5 lists the plant species present in the bottomland hardwood forests at the LES property and their abundance.

2.7.1.2 Identification of Important Species

The LES property contains a number of commercially valuable timber species. Commercially valuable species are considered important species under the definitions of NRC Regulatory Guide 4.9. The timber species that occur most frequently on the CEC site (i.e., those identified in the previous section as being dominant or common) are listed in Table 2.7-6. These species are selected as important species for the site (Reference 1).

No other plant species are selected as important species for the CEC site. Based on communications with the U.S. Fish and Wildlife Service (Reference 3) and the Louisiana Natural Heritage Program (Reference 4), no federally endangered or threatened plant species occur on or near the LES property. Several State rare plant species have been documented within a 15-mi radius of Homer, Louisiana and could be present at the site, although they were not documented during the site botanical survey conducted in June 1990. Those species are listed in Table 2.7-7 along with their State ranking assigned by the Louisiana National Heritage Program. However, because these species are not endangered or threatened, as defined under the Endangered Species Act, and do not meet any of the other criteria of important species as defined in NRC Regulatory Guide 4.9, they are not selected as important species for the CEC site (Reference 1).

2.7.1.3 Preexisting Environmental Stresses

Preexisting environmental stresses on the plant communities at the CEC site consist of timbering (including recent clearcutting) and grazing. Timbering has had the most wide-spread effect on vegetation at the site; approximately 61% of the total land area of the site has been clearcut in the last year and approximately 94% of the total land area has been timbered in the past 10 years. Timbering alters the composition, structure, and function of the plant community. In general, forest communities are more productive and have greater stability and structural diversity than the herb- and shrub-dominated communities that replace them following timbering. The net result of timbering (particularly clearcutting) is a movement of the plant community to earlier stages of succession. Heavier degrees of cutting as well as exposure of mineral soil initiate earlier stages of succession. An area approximately an acre in size located just south of the small on-site pond has had all vegetation removed and the mineral soil exposed. This area is probably one of the areas most severely impacted as a result of timbering on the LES property.

Cattle grazing on the site occurs in the upland mixed forest and the pine-dominated upland forest east of Parish Road 39. The net effect of grazing is a maintenance of herbaceous-dominated communities characteristic of earlier stages of succession; woody species, characteristic of later stages of succession do not become established extensively in grazed areas. This pattern was apparent in the grazed areas at the site which were interspersed with small clearings dominated by herbaceous plants. The fact that forests are established in the pasture areas indicates that either grazing did not begin until forest species already were established and/or that grazing has not been intense or extensive enough to inhibit forest regeneration across the entire area.

Roads that have been constructed at the site also constitute a preexisting environmental stress. The open areas associated with the roads (i.e., vegetated areas without canopy cover) often support herbaceous species different than those present on the forest floor. This pattern was apparent near roads in the upland mixed forest areas that were harvested between 5 and 10 years ago.

No other environmental stresses on the terrestrial plant community (e.g., disease, chemical pollutants) have been documented at the CEC site.

2.7.1.4 Species-Environment Relationships for Important Species

The abundance and distribution of commercially important timber species at the CEC site depend upon the interaction of these species with their environment. This interaction is reflected in the successional processes that occur within the plant community As a result of preexisting environmental stresses (particularly timbering), the successional stages of several of the forest communities at the site have been altered significantly, moving towards earlier stages of succession. However, over time, these communities will progress towards the more productive, more stable, and structurally more complex forest communities than they were before timbering. Because of this continual change, the baseline plant communities used to evaluate potential impacts of the CEC facility will be changing constantly. Therefore, any predictions of potential impacts of the facility must necessarily consider the natural successional processes that will be occurring at the CEC site.

Based on a knowledge of the existing plant communities at the site, as well as a knowledge of the pre-timbering plant communities, it is possible to predict the species composition of future communities at the site. For each of the plant communities identified at the site, the probable successional sequence of plant species is discussed below. The effects of succession on the abundance and distribution of commercially important timber species at the CEC site also is discussed.

2.7.1.4.1 Upland Mixed Forest--Recent Harvest

As discussed previously, the vegetative community in the recently harvested area is comprised of a variety of herbaceous species which are growing amid the slash and in other areas where trees and shrubs have been removed. Many of these species (e.g., panic grass, dogfennel, fireweed) are termed invader species because they exhibit the ability to quickly colonize (invade) disturbed areas. These species will continue to thrive over the next two or three years in the recently disturbed areas where woody vegetation has been removed. In areas where the mineral soil has been exposed (e.g., south of the small on-site pond), these and other invader species probably will dominate the plant community for a longer period of time. As the vegetative community matures (i.e., moves towards a forested system), these invader herbaceous species will no longer be present, and other herbaceous species and woody species better adapted to the changing conditions in the developing community will begin to dominate the plant community.

Young woody plants typical of these slightly later stages of succession already have begun to appear in less disturbed areas. Among these are sassafras, sweetgum, winged sumac, persimmon, and loblolly pine. These species should dominate the new forest in the less disturbed areas for the next several years (5 to 10 years). However, as the new forest matures, commercially important timber species are likely to become dominant. Scattered hardwood timber species left uncut and root sprouts from cut timber species will contribute to the regeneration of timber species in the area. Common timber species at maturity likely include sweetgum, loblolly pine, red maple, hickory, southern red oak, and other oaks.

2.7.1.4.2 Upland Mixed Forest--Several Years Since Harvest

The upland mixed forest harvested between 5 and 10 years ago is dominated by loblolly pine and sweetgum, and these commercial timber species probably will remain the dominant species as this forest reaches maturity. Other timber species likely to be common in the mature forest of this area include red maple, southern red oak, white oak, water oak (Quercus nigra), bitternut hickory (Carya cordiformis), mockernut hickory (Carya tomentosa), and black gum. These species are currently present in the forest but, with the exception of red maple and southern red oak, are not common species in the community. During the maturation of the forest, these currently less common species will become more abundant. Also as the forest matures, the understory will greatly thin and will be represented primarily by such species as hop hornbeam (Ostrya virginiana), American holly (Ilex opaca), indian cherry (Rhamnus caroliniana), wax myrtle (Myrica cerifera), and flowering dogwood (Cornus florida).

2.7.1.4.3 Upland Forest--Pine Dominated

This area is currently dominated by loblolly pine. Pine regeneration is much stronger in this forest area than in any other portion of the CEC site, and although there is no current evidence, it is possible that some form of forest management occurred formerly in this area to ensure pine dominance. This forest is well developed and it is unlikely that succession will change the species composition to any significant extent. Sweetgum is the common woody species that occurs with loblolly pine in the area and carpet grass (Azonopis affinis) and dog fennel are the common herbaceous species.

2.7.1.4.4 Upland Mixed Forest--Mature

This forest represents the most mature stand of timber on the LES property and provides an example of the forest composition west of Parish Road 39 before the recent clearcutting. Although some changes in composition may occur, it is probable that succession in the recently clearcut areas will proceed towards the species composition currently observed in this mature upland forest. This forest is dominated by loblolly pine, southern red oak, and red maple, all commercially important timber species. White oak, black gum, and water oak are other timber species that occur commonly in this forest. It is unlikely that succession will significantly modify the species composition in this mature forest.

2.7.1.4.5 Bottomland Hardwood Forests

The species composition of the bottomland hardwood forests is determined by the hydrologic conditions of the area. Species which are adapted to withstand periodic inundation have a competitive advantage over species better adapted to drier, upland conditions. Consequently, red maple, sweetgum, black gum, common alder, and blue beech (all able to withstand periodic wet soil conditions) are the common woody species in the bottomland hardwood forests on the LES property. Loblolly pine, southern red oak, white oak, and other species which are prevalent on drier upland sites are absent or are found less frequently in the bottomlands of the site. Given the current species composition, it is unlikely that succession will result in significant changes in the species composition of the bottomland forests at the site. The most probable change will be a thinning of the understory as the forest matures.

2.7.2 TERRESTRIAL ECOLOGY: WILDLIFE

The wildlife species that occur at the LES property, with a few exceptions, are most likely typical of that for other southeastern mixed forest systems. According to Bailey (Reference 5), whitetail deer (Odocoileus virginianus), eastern cottontail (Silvilagus floridanus), racoon (Procyon lotor), red fox (Vulpes fulva), and gray fox (Urocyon cinereoargenteus) are common mammalian species in most southeastern mixed forest systems. If deciduous trees are present on uplands, fox squirrels (Sciurus niger) are likely to be common, whereas gray squirrels (Sciurus carolinensis) are more common along intersecting drainages where mature, nut-producing trees are present. Common game birds include wild turkey (Meleagris gallopavo), bobwhite quail (Colinus virginianus), and mourning dove (Zenaida macroura). Common song birds include Carolina wren (Thryothorus ludovicianus), ruby throated hummingbird (Archilochus colubris), blue jay (Cyancocitta cristata), hooded warbler (Wilsonia citrina), and tufted titmouse (Parus bicolor). Reptiles include forest snakes such as cottonmouth (Agkistrodon piscivorous), copperhead (Agkistrodon contortrix), rough green snake (Opeodrys aestivus), coachwhip (Masticophis flagellum), and speckled kingsnake (Lampropeltis getulus), as well as a variety of turtles and skinks (Reference 5).

2.7.2.1 Wildlife Species at the CEC Site

The particular species composition of the wildlife community at the site is a direct function of the type, quality, and quantity of habitat that is available. Factors such as the age of the timber stands, the percent of deciduous trees, the presence or proximity of openings within the forest, and the presence of bottomland forests directly influence the species composition at the site. Given information on the particular habitats that exist at the site (e.g., recently cut upland mixed forests, pine-dominated forest), along with information on the regional and local distribution of wildlife species and on species-specific habitat preferences, the wildlife species likely to occur at the CEC site can be identified. The mammals, birds, amphibians, and reptiles known or expected to occur on the CEC site are discussed below.

2.7.2.1.1 Mammals

The mammalian species potentially occurring on the site are listed in Table 2.7-8. The species listed are those identified by the Louisiana Natural Heritage Program (Reference 4) as occurring in the watershed that includes the town of Homer, in Claiborne Parish, approximately five miles from the site. No site-specific field survey was conducted at this time to identify the mammals that occur at the site.

Table 2.7-8 also lists the general habitat requirements for each mammalian species potentially occurring at the site along with qualitative estimates of its probable distribution and abundance at the site. These estimates were derived based on a knowledge of the species-specific habitat preferences and the current composition, structure, and extent of the vegetative communities at the site. It is likely that the distribution and abundance of at least some of the mammalian species will change in the future as the vegetative communities of the site continue to develop as a result of natural selection or are further affected by man. For example, gray squirrels probably are not currently abundant at the site because a large percentage of the site's mature, nut-producing trees (e.g., oaks, hickories) upon which this species relies for food were removed during the recent clearcutting. However, the number of gray squirrels is likely to increase in the future as the mixed hardwood forests of the site regenerate and nut-producing trees mature.

2.7.2.1.2 Birds

Table 2.7-9 lists the bird species that may occur on the site along with their migratory and nesting status. The 177 species listed were selectively chosen from the Checklist of North American Birds (Reference 6) as those likely to live in or visit the region. Of these, approximately 96 species are likely to be summer residents, of which 78 may nest on the site. Approximately 93 of the 177 species are probable winter residents of the site.

Site-specific avian surveys were conducted in January (three days) and April (one day) 1990 to verify the presence of particular bird species at the site. (The January survey was conducted before the recent clearcutting occurred, and the April survey was conducted after the majority of the timber harvesting had been completed.) A total of 65 species were identified during the surveys; 40 of these species were identified during the January survey and 51 were identified during the April survey. The species seen or heard on the LES property during the surveys are noted in Table 2.7-9.

A breeding bird census also was conducted as part of the April survey. Breeding birds were identified for three of the five principal vegetative communities on the site: 1) upland mixed forests--several years since harvest; 2) mature upland mixed forest; and 3) upland mixed forest--recently harvested. In all, 198 territorial males of 41 species were identified for the site. The greatest number of territorial males (120) were found in the upland mixed forest which had not been harvested for several years; 73 territorial males were found in the mature forest and only 4 territorial males were found in the recently harvested upland mixed forest. The mature forest had a greater number of nesting species (34) than either the recently harvested area (4) or the upland mixed forest that has not been harvested for several years (20). Based on the total number of territorial males, it was estimated that approximately 160 nests occurred across the surveyed portions of the site.

2.7.2.1.3 Amphibians and Reptiles

The amphibians and reptiles potentially occurring on the site are listed in Table 2.7-10. The species listed are those identified by the Louisiana Natural Heritage Program (Reference 4) as occurring in the watershed that includes the town of Homer, in Claiborne Parish, approximately five miles from the CEC site.

Table 2.7-10 also lists the general habitat requirements for each amphibian or reptile species potentially occurring at the site along with estimates of each species' probable distribution at the site.

The distribution of amphibians at the site is probably closely tied to the availability of water. The on-site pond and Lake Avalyn likely provide permanent or breeding habitat for a variety of amphibian species including spotted salamander (Ambystoma maculatum), northern cricket frog (Acris crepitans crepitans), eastern narrowmouth toad (Gastrophryne carolinensis), bullfrog (Rana catesbeiana), and southern leopard frog (Rana sphenocephala). Swampy areas in the bottomland hardwood forests of the CEC site may provide permanent or breeding habitat for dwarf salamander (Eurycea quadridigitata) and upland chorus frog (Pseudacris triseriata feriarum), and streams of the area may support populations of northern dusky salamander (Desmongnathus fuscus fuscus) and bronze frog (Rana clamitans).

The distribution of some of the reptiles potentially occurring at the site also is determined or influenced by the presence of water. For example, any snapping turtles (Cheldta serpentina serpentina), red-eared sliders (Chrysemys scripta elegans), eastern mud turtles (Kinosternon subrubrum subrubrum), and stinkpots (Sternotherus odoratus) that occur at the site are likely to be limited to the small on-site pond and Lake Avalyn. The distribution of diamondback water snake (Nerodia rhombifera) and western cottonmouth (Agkistrodon piscivorous leucostoma) also are determined by the presence of water. The distribution of the other reptiles potentially occurring at the CEC site is not influenced significantly by the presence of water.

2.7.2.2 Identification of Important Species

Based on information from the U.S. Fish and Wildlife Service (Reference 3), the CEC site is located within the historic or known range of six federally endangered wildlife species. These species are listed in Table 2.7-11. It is not known if these species occur on the site. However, none of these species has been documented within a 15-mi radius of Homer, Louisiana (Reference 4), which is located 5 mi from the site. Further, based on information regarding each species' historical occurrence in the area and/or species-specific habitat requirements, it is considered unlikely that any of these species would occur at the site, or if they did occur, would use the site to any significant degree. Recent clearcutting at the site probably would discourage use by any of these species. Species-specific discussions follow.

a. Florida panther (Felis concolorcoryi): The existence in the florida panther has been rarely confirmed in Louisiana (Reference 7). Further, this species requires large expanses of wilderness area for survival, which is not provided by the habitat on or surrounding the CEC site.

b. Eskimo curlew (Numenius borealis): The Eskimo curlew was once a common migrant in Louisiana. However, its presence in the State has not been confirmed since 1889 (Reference 8). Range-wide, only eight members of this species have been recorded since 1959 (Reference 3).

c. Bachman's warbler (Vermivora bachmanii): The Bachman's warbler has been verified as occurring in Louisiana less than 12 times since 1889 (Reference 8), although there have been several unconfirmed sightings in the State (Reference 3). Most authorities agree that if the Bachman's warbler still exists, it is probably limited to locations in South Carolina (Reference 3).

d. Ivory-billed woodpecker (Campephilus principalis): The ivory-billed woodpecker is probably extinct across its entire range (Reference 3). If it does exist, it is believed to require extensive mature stands of lowland hardwood forest that have not been disturbed by cutting, a condition that does not exist at the CEC site.

e. Red-cockaded woodpecker (Picoides borealis): Red-cockaded woodpeckers require open stands of mature pines with a minimum age of 60 years (Reference 9). Pine stands of this age do not exist on the CEC site due to recent and historical timbering on the property.

f. Bald eagle (Haliaeetus leucocephalus): Inland, bald eagles typically occur along freshwater lakes and rivers. There are many records for this species throughout Louisiana, including all areas in northern Louisiana where large lakes occur. Bald eagles may, in fact, occur in Lake Claiborne, located approximately five miles south of the CEC site although their existence there has not been recorded by the Louisiana Natural Heritage Program (Reference 4). However, it is considered unlikely that bald eagles would use the site due to a lack of appropriate habitat (i.e., large waterbodies) on the site. It is possible that bald eagles are transients in the site area, given the site's close proximity to potentially suitable habitat at Lake Claiborne.

In the absence of endangered or threatened species that occur at the site or that use the site to any significant degree, the important wildlife species (as defined in NRC Regulatory Guide 4.9) at the site are selected based on considerations of recreational or commercial value (Reference 1). Table 2.7-12 lists the recreationally or commercially important wildlife species potentially occurring on the CEC site. Of these species, white-tailed deer and rabbit are the principal game species and raccoon the principal furbearer in northwest Louisiana (Reference 10, 11). Therefore, these three species are selected as important species for the CEC site. The other listed species are less important recreationally or commercially in this portion of the state (Reference 10, 11) and, therefore, are not selected as important species.

No other wildlife species are selected as important species for the site.

2.7.2.3 Species-Environment Relationships for Important Species

The abundance and distribution of whitetail deer, cottontail, and raccoon at the site depend upon the interaction of these species with their environment. These interactions are defined by each species' habitat requirements, life history, and population dynamics. Below, species-environment relationships are described for the three terrestrial wildlife species selected as important species for the site.

2.7.2.3.1 Whitetail Deer

Habitat Requirements. Whitetail deer require suitable food, cover, water and space. Probably the ideal mix of these four components in the southeast coastal plain (including the CEC site area) is large blocks of dense cover within forested areas having limited tree canopy cover (to insure understory food production) and common sources of fresh water (Reference 12).

Whitetail deer are large ruminants that require large quantities of easily digested food to satisfy their metabolic requirements for maintenance, growth, and reproduction (Reference 12). Deer browse on a variety of woody deciduous plants and some coniferous plants. Loblolly pine/hardwood habitats, such as those at the CEC site, support a wide variety of plant species that are used as forage by deer. Consequently, these forests typically are capable of supporting large deer populations. Table 2.7-13 lists the plant species used as food by deer in northwest Louisiana along with the abundance of these species on the CEC site. As can be seen from the table, many of the browse species preferred by deer are present on the site. Some of these species are currently common in some habitats at the site (e.g., red maple in recently cut areas and in bottomland hardwoods, blue beech in bottomlands), while others not currently abundant (e.g., white oak, water oak) are expected to increase in the future as the vegetative communities of the site mature. Thus, the CEC site likely satisfies the forage requirements of whitetail deer.

Water availability also does not appear to be a limiting factor for deer populations at the site, given the presence of the pond, Lake Avalyn, and a few small drainage ways at the site. Short, in developing habitat suitability models for whitetail deer, assumes that a drinking water source must be located within a mile of a site for that site to be considered adequate deer habitat (Reference 12). The CEC site meets this requirement.

Estimates of adequate cover are less precise. Harlow lists swamps and dense honeysuckle (*Lonicera spp.*) thickets as suitable cover for whitetail deer, and this type of cover is provided to some degree at the site (Reference 13). Short states that cover is usually adequate in Gulf coastal plain habitats except perhaps in large tracts of recently cleared forest lands, or in areas where brush has been cleared to favor grass production (Reference 12). Thus, it is likely that adequate deer cover has been reduced across 271 acres of the site which have been recently timbered. However, the amount of adequate cover will increase as the vegetative community of the recently timbered area develops. Based on the understory plant density in some of the less recently timbered forests at the site, adequate cover could develop in five years or less.

Space requirements for deer are based on consideration of typical population densities and home range areas of deer as well as the carrying capacity of the habitat. St. Amant conservatively estimated that pine/hardwood stands in northwest Louisiana could support 1 deer per 50 acres (Reference 14). Based on this estimate and assuming that all habitat on the LES property is suitable, the site could support a maximum of approximately 10 deer. Other authors have had different estimates on the minimum space requirements for whitetail deer. For example, Short estimates that at least 100 acres/deer of contiguous habitat is required before whitetail deer will live and reproduce in an area (Reference 12). Using this assumption, the CEC site could support approximately 5 deer.

Life History. Whitetail deer are considered to be a K-selected species, which means that natural selection operates on traits that influence survivorship and competitive ability at population densities near the carrying capacity of the environment (K), rather than selection on traits that favor rapid population growth at low population densities. K-selected species tend to be long lived and exhibit low fecundity and emigration rates.

Whitetail deer typically reach sexual maturity at 18 months, although some females may mate as yearlings (Reference 15). The breeding season is approximately November through February and the gestation period is approximately 6.5 months (Reference 16). Average litter size is 2 young per female per year. Fecundity rapidly increases from 18 months of age to 3 years of age and then levels off between 3 and 6 years of age (Reference 17). Young typically stay with the mother for a year.

Population Dynamics. Whitetail deer are a gregarious species and usually travel in small groups. During the summer and fall, family groups consisting of a doe and her fawns are common. Yearlings sometimes join these family groups in late fall. In winter, groups of 25 deer or more are common (Reference 16).

2.7.2.3.2 Eastern Cottontail

Habitat Requirements. Eastern cottontails are found in a wide variety of disturbed, successional, and transitional habitats often characterized by weedy forbs and bunch-type perennial grasses with an abundance of well-distributed escape sites (Reference 18). This species avoids dense woodlands.

Rabbits are herbivores, but the wide variety of plant foods utilized by them makes food of little or no consequence in their distribution (Reference 14). Conversely, because of the cottontail's susceptibility to avian and mammalian predators, cover is one of the most important habitat requirements for this species and may be a limiting factor in rabbit population growth. Cover often consists of dense, thorny, low-growing, woody perennials (Reference 18). However, brush piles in cut-over woodlands also provide shelter, as well as an adequate supply of winter food in the form of stump sprouts and exposed shrubby and herbaceous vegetation (Reference 18). Given these general cover type requirements, it is probable that the vegetative communities of the CEC site provide adequate cover to support cottontail populations. The recent timbering at the site has probably increased the amount of available cover for this species.

If cover and other habitat requirements are met, local populations of cottontails may occasionally reach densities of eight animals per acre, but typical population densities are considerably lower (Reference 18).

Life History. Cottontails are considered an r-selected species which means that natural selection operates on traits that increase fecundity, with density regulated primarily through mortality (survival) and dispersal. r-Selected species tend to be short lived and exhibit high fecundity and emigration rates.

In Louisiana, cottontails breed every month of the year with the peak breeding season beginning in February and continuing through September (Reference 14). They produce up to 4 or more litters per year and the total number of young produced per year per female is potentially 25 or more (Reference 14). However, mortality among the young is high and the number of offspring reaching maturity probably does not exceed 20% (Reference 14). Young disperse at about 7 weeks of age and reach sexual maturity in 2 to 3 months (Reference 15). Most females breed the first spring following birth (Reference 15).

Population Dynamics. Cottontail population dynamics are controlled to a large degree by the age and breeding status of individual members. During the fall and winter, cottontail populations contain two cohorts: one comprised of residents with fixed home ranges and the other comprised of individuals that disperse to colonize newly favorable habitats or to recolonize understocked habitats (Reference 15). The resident cohort represents cottontails that have bred, while the dispersing element is composed of younger individuals that have not yet bred. The change from disperser to resident is believed to be related to the onset of reproduction.

In general, cottontails do not maintain territories, and the home ranges of different age and sex classes overlap broadly during much of the year, and in particular during the late fall and winter when cottontails tend to concentrate in areas offering the best combination of food and escape cover (Reference 15).

2.7.2.3.3 Raccoon

Habitat Requirements. Raccoon inhabit wooded areas interrupted by fields and water courses. This species is relatively scarce in dry upland woodlands, especially where pines are mixed with hardwoods, and in southern pine forests (Reference 19). Raccoon at the CEC site are probably limited to areas near the on-site pond and lake and in bottomlands along drainage ways.

Raccoons are omnivorous and opportunistic feeders. Animal matter is the major food item in spring and early summer and vegetative matter is the primary food item at other times of the year (Reference 15). Fleshy fruits, including wild grape (Vitis spp.), cherries (Prunus spp.) persimmons (Diospyros spp.) are important summer foods; acorns (Quercus spp.) and other nuts are important foods in the fall and winter (Reference 19). Each of these food items is found at the CEC site.

Raccoons also require cover for winter dens, for parturition areas, and for daytime sleep areas in the summer. Hollow trees are the preferred cover choice, although a variety of other sites also are used.

Life History. Raccoons are considered a K-selected species. Mating generally occurs from January to March, with a peak in February (Reference 19). Gestation is approximately 63 days and parturition occurs in April or May (Reference 16). Litter sizes range between 2 and 5 (Reference 15). One litter per year is produced per female. Approximately half of the females breed as yearlings and the remaining breed when they are two years old (Reference 15). Young stay with their mother until the fall (Reference 16).

Population Dynamics. The most common social group for raccoons consist of a mother and her young of the year (Reference 19). Other aggregations of individuals are uncommon in this solitary species and are limited to winter denning groups and temporary feeding aggregations. These animals do not appear to be territorial and individual home ranges overlap broadly at times. Individual home ranges generally are in the range of 100 to 250 acres. Population densities range from 1 raccoon per 100 acres to 1 raccoon per 20 acres (Reference 19).

2.7.2.4 Preexisting Environmental Stresses

Recent timbering operations represent the primary preexisting environmental stress on the wildlife community of the site. As discussed earlier, timbering alters the composition, structure, and function of the plant community, which in turn alters the composition, structure and function of the associated wildlife community.

The most probable result of the recent clearcutting on the site is a shift from species associated with mature forests to those associated with scrub-shrub or young forest habitats. For example, the populations of forest interior bird species such as hairy woodpecker (Picoides villosus), yellow-billed cuckoo (Coccyzus americanus), acadian flycatcher (Empidonax virescens), and red-eyed vireo (Vireo olivaceus) probably have decreased as a result of the recent cutting, whereas those of forest edge-associated species, such as rufous-sided towhee (Pipilo erythrophthalmus), song sparrow (Melospiza melodia), and American goldfinch (Carduelis tristis), probably have increased. Mammals such as gray fox (which prefer mature, open forests) and gray squirrel (which prefer forests with mature nut trees) probably will be negatively affected. Conversely, cottontail populations at the site may have increased as a result of the recent clearcutting, which resulted in the creation of open areas with heavy brush. Whitetail deer populations probably will benefit from increased food in the clearcut areas, after cover is reestablished. Raccoon also may benefit from the recent clearcutting, as these species are not typically found in dense forests.

Any changes in the wildlife community as a result of the clearcutting are likely to be short-term, and species distribution and abundance are likely to return to previous levels as the vegetative communities of the site approach pre-timbering conditions. Thus, it is possible that the populations of the important species at the site will increase over the next several years following clearcutting, but eventually will decrease as the forests matures.

No other environmental stresses on the terrestrial wildlife community (e.g., disease, chemical pollutants) have been documented at the CEC site.

2.7.3 AQUATIC ECOLOGY

Aquatic habitat on the LES property consists of Lake Avalyn in the northeast corner, Bluegill Pond in the southwest corner, small streams, and a small wetland area near the Lake Avalyn overflow discharge point. Both Lake Avalyn and Bluegill Pond are dammed and receive drainage from the surrounding area.

2.7.3.1 Aquatic Organisms

On-site surveys were conducted in January and May 1990 to identify the aquatic organisms in Bluegill Pond and in Lake Avalyn. This information is used in conjunction with information on species habitat preferences and on species occurrence within the region to identify those species that may occur at the CEC site. The plant and animal components of the aquatic environments at the site are discussed below.

2.7.3.1.1 Plants

Table 2.7-14 lists the phytoplankton and macrophytes identified in Bluegill Pond and/or Lake Avalyn during on-site surveys in January (phytoplankton) and June (macrophytes) of 1990.

The phytoplankton of both the pond and the lake is dominated by yellow-green algae (Chrysophyta). Yellow-green algae blooms of Synura and Dinobryon comprised approximately 91% of the phytoplankton in Lake Avalyn and approximately 82% of the phytoplankton in Bluegill Pond. Synura grows well under ice and the abundance of this algae during the January survey may have been a result of the iced-over conditions in both the pond and the lake for two to three weeks in December 1989.

The macrophytic community of Lake Avalyn is much more abundant and diverse than that in Bluegill Pond. Smartweed (Polygonum sp.) was the only macrophyte found in the water of the pond, whereas 11 species of macrophytes were identified in the water of Lake Avalyn. Horned pondweed (Zannichellia palustris) was the most common macrophyte in all surveyed areas of Lake Avalyn; smartweed, marsh purslane (Ludwigia palustris), and rush (Juncus repens) were locally common in selected areas of the lake.

The phytoplankton and macrophyte communities of the small on-site streams or the small wetland near the Lake Avalyn overflow discharge point were not sampled, and therefore the species composition of the aquatic plant communities in these areas is not known. However, many of the same species of macrophytes that were found in Lake Avalyn could occur in these other aquatic habitats, particularly in the small wetland area. The phytoplankton communities in these areas may be reduced from those observed in the pond and lake because phytoplankton in lotic (running water) systems are generally less abundant and less stable than those in lentic (still water) environments.

2.7.3.1.2 Animals

Tables 2.7-15 and 2.7-16 list the invertebrate (zooplankton and benthic species) and fish species, respectively, that may occur in Bluegill Pond and Lake Avalyn. The invertebrate species listed in Table 2.15-15 are those identified during an on-site survey conducted in January 1990 or those which, based on habitat considerations, are expected to occur in the pond or lake. The fish species listed are those identified during the on-site aquatic survey or those identified by the Louisiana Department of Wildlife and Fisheries as typical of small, warm water ponds in northwest Louisiana (Reference 7). Some of the fish species listed (i.e. spotted bass [Micropterus punctulatus] and alligator gar [Atractosteus spatula]) are more likely to inhabit larger lakes or streams, and although potentially occurring at the CEC site, are unlikely.

Invertebrates consist of zooplankton which live in the water column and benthic (bottom-dwelling) species. The zooplankton communities in both lakes were low in total numbers and lacked diversity compared to that expected in similar waters in Louisiana. The lower densities of some species of zooplankton may be attributable to the time of sampling (winter, morning). The benthic species collected were typical of those found in relatively undisturbed lentic environments. Invertebrates in on-site streams and the small wetland were not sampled. Probable invertebrates in these environments include copepods, crayfish, and insects.

Fish species belonging to the families Centrarchidae (e.g., sunfish, bass, crappie) and Ictaluridae (catfish) are expected to dominate small impoundments, such as those on the CEC site. Of the 11 species of fish that were identified in Bluegill Pond or Lake Avalyn, 5 were centrarchids; no other family had more than 1 species representative in the sampled waters. No catfish were collected from either lake, but this could be because during the winter months, catfish move to deeper waters, which were not sampled during the on-site survey.

The on-site streams and small wetland were not sampled for fish. However, common fish species in these aquatic environments are probably limited to smaller species such as mosquitofish (Gambusia affinis) and darters (Etheostoma gracile).

2.7.3.2 Important Aquatic Species

According to the U.S Fish and Wildlife Service (Reference 3) and the Louisiana Natural Heritage Program (Reference 4), no federally threatened or endangered aquatic species occur in the CEC site area. In the absence of endangered or threatened species at the site, the important aquatic species (as defined in NRC Regulatory Guide 4.9) at the site are selected based on considerations of recreational value. Game fish in northwest Louisiana ponds and lakes include bass, crappie, sunfish, and catfish (Reference 7). Each of these species groups is selected as important for the site. For the purposes of this report, representative species from each group are selected as important, as follows: bass--largemouth bass (Micropterus salmoides); crappie--white crappie (Pomoxis annularis); sunfish--bluegill (Lepomis macrochirus); and catfish--channel catfish (Ictalurus punctatus). Bluegill are known to occur in both Bluegill Pond and Lake Avalyn; the other species have not been observed but may occur in these waters.

2.7.3.3 Species-Environment Relationships for Important Species

Below, species-environment relationships are described for the four fish species selected as important for the CEC site.

2.7.3.3.1 Largemouth Bass

Habitat Requirements. Lakes are the preferred habitat of largemouth bass, although they also occur in large, slow-moving rivers. Optimal lake habitat consists of lakes with extensive ($\geq$

25%) shallow areas to support submerged vegetation, yet deep enough (10 to 50 ft.) to successfully overwinter bass. Flooded vegetation is an important requirement for fry habitat suitability. Both Bluegill Pond and Lake Avalyn are deep enough to overwinter bass. However, Lake Avalyn may provide better bass habitat due to a greater amount of flooded vegetation. Food preferences vary with lifestage: adult largemouth bass feed primarily on fish and crayfish, juveniles consume mostly insects, and fry feed mainly on microcrustaceans and small insects (Reference 20).

Largemouth bass are sensitive to changes in water quality parameters. Growth of largemouth bass is reduced at dissolved oxygen levels less than 8 mg/L and distress may be evident at levels of 5 mg/L. Largemouth bass also are intolerant of suspended solids and sediment. Moderate to high levels of suspended solids (25 ppm or greater) may interfere with reproductive processes and reduce growth. Largemouth bass require a pH between 5 and 10 for successful reproduction, although the species can tolerate short-term exposures to pH levels of 3.9 to 10.5 (Reference 20).

Life History. Largemouth bass are a long-lived species and largemouth bass up to 15 years of age have been recorded. Largemouth bass mature and spawn as early as their 2nd year (age I) in southern portions of their range. Spawning generally begins in the spring and occurs in low-velocity (< 1 ft./sec.) waters at depths between 0.5 to 25 ft. Optimal temperatures for spawning and incubation are approximately 20 C (Reference 20).

2.7.3.3.2 White Crappie

Habitat Requirements. White crappie inhabit freshwater lakes as well as low-velocity pools and overflow areas of larger rivers. The species is most abundant in lakes and reservoirs greater than 5 acres in size. Based on this, white crappie are likely to be more abundant in Lake Avalyn than in Bluegill Pond. The availability and quality of both food and cover are important habitat characteristics influencing the distribution of white crappie within a given aquatic environment, but, the quality and quantity of food is probably one of the most important limiting factors. Adult and juvenile white crappie forage in open water and feed almost exclusively on fish. Fry feed on copepods, rotifers, and algae, switching to a variety of zooplankton and then insects as they grow larger (Reference 21).

White crappie tolerate dissolved oxygen concentrations as low as 3.3 mg/L, but a concentration of 5 mg/L probably is the lower limit at which optimal growth and survival occur. White crappie prefer moderately turbid waters, but the best growth occurs in clearer waters (< 50 JTU). However, black crappie (Pomoxis nigromaculatus) usually predominate in clear waters where they occur with white crappie (Reference 21).

Life History. White crappie have an average lifespan of 7 to 9 years. Individuals generally mature between their 2nd and 4th year (ages I to III). Spawning begins during March to July when water temperatures reach 13 C to 14 C; peak spawning occurs at water temperatures of 16 C to 20 C. Nests are typically constructed on substrates of clay, dirt, or gravel near inundated vegetation (Reference 21).

2.7.3.3.3 Channel catfish

Habitat Requirements. Channel catfish occur over a broad range of habitats, but are most abundant in large riverine systems. In lake environments, channel catfish [illegible]r sand, gravel or rubble substrates over shoals and in deep, protected areas. Optimal lake habitat for channel catfish appears to be large, fertile, warm lakes with clear to moderate turbidities, and abundant cover of logs, boulders, and cavities. Diet varies with age class. Young-of-the-year catfish (age 0) feed predominantly on plankton and aquatic insects. Adult catfish are opportunistic feeders and are able to locate suitable food in a variety of habitats. The adult catfish diet includes insects, detrital and plant material, crayfish, and mollusks (Reference 22).

Growth is greatest in clear waters with dissolved oxygen levels greater than 5 mg/L. Dissolved oxygen levels above 7 mg/L are optimum for survival and growth of channel catfish embryos and larvae (Reference 22).

Life History. Channel catfish are a long-lived species. Age at maturity is variable, but southern channel catfish generally mature in their 6th year (age V). Channel catfish spawn in late spring and early summer. Males build and guard nests in cavities, burrows, under rocks, and in other dark, secluded, protected sites (Reference 22).

2.7.3.3.4 Bluegill

Habitat Requirements. Bluegill inhabit clear, warm pools of streams, lakes, ponds and sloughs, and within these habitats, usually occur in shallow waters with vegetation (Reference 24). Optimal lake habitat is characterized by fertile waters with extensive (≥ 20% of total lake surface area) littoral areas. Bluegills are opportunistic feeders and alter their diet according to food availability. Fry feed primarily on zooplankton and small insects. Juveniles and adults feed primarily on zooplankton, aquatic and terrestrial insects, and some plant materials (Reference 23).

Optimal growth and reproduction occur in clear to moderately turbid waters. Bluegill can tolerate dissolved oxygen levels as low as < 1 mg/L for short durations, but optimal levels are > 5 mg/L. Optimal pH is in the range of 6.5 to 8.5 (Reference 22).

Life History. Bluegills generally live between 1 and 4 years although a maximum age of 11 years has been recorded. Individuals generally mature in their 2nd or 3rd year (age I or II). Bluegills are repeat spawners, and the spawning may extend from spring through summer. Nests are built in quiet, shallow (3 to 10 ft.) water (Reference 23).

2.7.3.4 Preexisting Environmental Stresses

Recent timbering operations represent the primary source of preexisting stress on the aquatic communities of the CEC site. It is probable that the recent clearcutting has resulted in an increased erosion in timbered areas which can result in an increased sediment and nutrient load to both Bluegill Pond and Lake Avalyn. This can result in increased turbidity and siltation in these aquatic environments. The potential for increased turbidity and siltation is greatest for Bluegill Pond as the clearcutting in the area near the pond was more extensive and severe than that surrounding Lake Avalyn. A comparison of turbidity measurements collected from Bluegill Pond in January 1990 (before the clearcutting) and May 1990 (after the clearcutting) suggests that the pond has been impacted by the timbering operations. Turbidity in January was approximately 8 NTU whereas in May it was 48 NTU. Turbidity in Lake Avalyn was essentially unchanged. It is probable that the increased turbidity in the pond is due to an increased sediment load to the pond as a result of clearcutting.

Increased turbidity and siltation can have varying effects on the growth, reproduction and survival of the important aquatic species at the CEC site. For example, moderate to high levels of suspended solids may interfere with reproduction and growth in largemouth bass, whereas moderate turbidity levels are favored by white crappie. Bluegill reproduce and grow optimally in clear and moderately turbid waters, and thus may be less affected by small changes in turbidity. In general, increased siltation is likely to result in a decreased number of fish spawning sites, particularly for nest building species such as the species selected as important species for this evaluation.
An increase in organic matter in the pond or lake also could result in increased biological oxygen demand as bacteria utilize oxygen while they decompose the organic matter. This, in turn, could result in lowered dissolved oxygen concentrations within the water column and result in a decrease in the number of gilled species in the water. Average dissolved oxygen levels were substantially lower in post-timbering (May) samples than in pre-timbering (January) samples in both the pond (3.1 vs. 9.0 mg/L)

and Lake Avalyn (2.8 vs. 8.3 mg/L), and this decrease could be the result on increased organic load to these waters as a result of timbering. However, the lower oxygen levels also could be a reflection of the higher level of biological activity typical of these ponds during warmer months of the year or be the result of higher temperatures alone.

Several of the important fish species are sensitive to lowered dissolved oxygen. For example, growth of largemouth bass is reduced at dissolved oxygen levels less than 8 mg/L and that of white crappie, bluegill, and channel catfish is reduced below optimum at levels below 5 mq/L.

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Table 2.7-1

Species Identified at the LES Site:
Upland Mixed Forest--Recently Harvested

HERBS AND VINES

Common[a]

Dichanthelium laxiflorum	Panic grass
Dichanthelium sphaerocarpon	Panic grass
Dichanthelium commutatum	Panic grass
Erechtites hieracifolia	Fireweed
Eupatorium capillifolium	Dogfennel
Lonicera japonica	Japanese honeysuckle
Parthenocissus quinquefolia	Virginia creeper
Vitis rotundifolia	Muscadine

Moderate[b]

Acalypha gracilens	Three-seeded mercury
Ambrosia artemisiifolia	Short ragweed
Cassia nictitans	Sensitive pea
Chasmanthium sessiliflorum	Spike grass
Conyza canadensis	Horse-weed
Croton capitatus	Doveweed
Cyperus ovularis	Hedgehog club rush
Desmodium sp.	Tick trefoil
Dichanthelium aciculare	Panic grass
Dichanthelium olisanthes	Panic grass
Diodia teres	Rough buttonweed
Juncus biflorus	Rush
Mollugo verticillata	Carpet weed
Rhus toxicodendron	Poison ivy
Rubus louisianus	Blackberry
Rubus trivialis	Southern dewberry
Smilax bona-nox	Catbrier
Smilax rotundifolia	Greenbrier
Vitis cinerea	Grayback grape

Scattered[c]

Axonopis affinis	Carpet grass
Berchemia scandens	Rattan
Carex complanata	Sedge
Centrosema virginianum	Butterfly pea
Chenopodium murale	Nettle-leaved goosefoot
Clematis virginiana	Virgin's bower
Clitoria mariana	Butterfly pea
Croton glandulosus	Croton

Table 2.7-1 (Continued)

Species Identified at the LES Site:
Upland Mixed Forest--Recently Harvested

HERBS AND VINES (continued)

Scattered[a] (continued)

Cynodon dactylon	Bermuda grass
Desmodium viridiflorum	Tick trefoil
Desmodium ciliare	Tick trefoil
Digitaria ciliaris	Crab grass
Digitaria filiformis	Slender crab grass
Elephantopus tomentosus	Elephant's foot
Euphorbia corollata	Flowering spurge
Gelsemium sempervirens	Carolina jessamine
Gnaphalium purpureum	Purple cudweed
Helenium amarum	Bitterweed
Heterotheca mariana	Golden aster
Juncus nodatus	Rush
Lactuca ludoviciana	Lettuce
Lespedeza striata	Japanese lespedeza
Lespedeza stuevei	Lespedeza
Lobelia apendiculata	Lobelia
Ludwigia palustris	Marsh purslane
Melothria pendula	Creeping cucumber
Oenothera biennis	Evening primrose
Oxalis priceae	Yellow wood sorrel
Oxalis dillenii	Yellow wood sorrel
Phytolacca americana	Pokeweed
Pluchea camphorata	Stinkweed
Polygala verticillata	Milkwort
Rhynchosia latifolia	Rhynchosia
Rudbeckia hirta	Brown-eyed susan
Smilax hispida	Greenbrier
Smilax glauca	Greenbrier
Solanum americanum	American nightshade
Solanum carolinense	Carolina horse-nettle
Trigia urticifolia	Trigia
Triodanis perfoliata	Venus' looking glass

WOODY SPECIES

Common[b]

Acer rubrum	Red maple
Callicarpa americana	American beautyberry
Fraxinus americana	White ash
Liquidambar styraciflua	Sweetgum

Table 2.7-1 (Cont'nued)

Species Identified at the .ES Site:
Upland Mixed Forest--Recently Harvested

WOODY SPECIES (continued)

Moderate[b]

Ostrya virginiana	Hop hornbeam
Quercus falcata	Southern red oak
Rhus copallina	Winged sumac
Sassafras albidum	Sassafras
Ascyrum hypericoides	St. Andrew's cross
Carya cordiformis	Bitternut hickory
Carya tomentosa	Mockernut hickory
Chionanthus virginica	Fringe tree
Diospyros virginiana	Persimmon
Hamamelis virginiana	Witch hazel
Ilex opaca	American holly
Myrica cerifera	Wax myrtle
Nyssa sylvatica	Black gum
Pinus taeda	Loblolly pine
Prunus serotina	Black cherry
Quercus stellata	Post oak
Quercus nigra	Water oak
Quercus alba	White oak
Rhamnus caroliniana	Indian cherry
Ulmus alata	Winged elm
Vaccinium arboreum	Farkleberry
Vaccinium amoenum	Huckleberry

Scattered[c]

Aesculus pavia	Buckeye
Albizia julibrissin	Mimosa
Aralia spinosa	Hercules'-club
Carya texana	Black hickory
Castanea pumila	Chinquapin
Cornus florida	Flowering dogwood
Fagus grandifolia	American beech
Juniperus virginiana	Red cedar
Morus rubra	Red mulberry
Pinus echinata	Shortleaf pine
Prunus umbellata	Flatwoods plum

Table 2.7-1 (Continued)

Species Identified at the LES Site:
Upland Mixed Forest--Recently Harvested

WOODY SPECIES (continued)

Scattered[c] (Continuted)

Rhus aromatica	Fragrant sumac
Rhus glabra	Smooth sumac
Vaccinium elliottii	Elliott's blueberry
Viburnum rufidulum	Southern black-haw
Viburnum dentatum	Southern arrow-wood

[a]Common species are those that may be noted at any random point within a specific vegetative community.

[b]Moderate species are those that may or may not be in view at any random point within a vegetative community but that may be located with a limited amount of searching.

[c]Scattered species are those that occur only a few times within a given vegetative community or that are abundant only in one or two localized areas.

Table 2.7-2

Species Identified at the LES Site:
Upland Mixed Forest--Several Years Since Harvest

HERBS AND VINES OF FOREST FLOOR

Moderate[a]

Chasmanthium sessiliflorum	Spike grass
Dichanthelium laxiflorum	Panic grass
Lonicera japonica	Japanese honeysuckle
Parthenocissus quinquefolia	Virginia creeper
Rhus toxicodendron	Poison ivy
Smilax bona-nox	Catbrier
Smilax rotundifolia	Greenbriar
Smilax glauca	Greenbrier
Vitis rotundifolia	Muscadine

Scattered[b]

Berchemia scandens	Rattan
Carex complanata	Sedge
Desmodium paniculatu	Tick trefoil
Dichanthelium commutatum	Panic grass
Elephantopus tomentosus	Elephant's foot
Erigeron strigosus	Daisy fleabane
Mitchella repens	Partridge berry
Rhynchosia latifolia	Rhynchosia
Rudbeckia hirta	Brown-eyed susan
Sabatia angularis	Rose pink
Sanicula canadensis	Black snakeroot
Sanicula smallii	Black snakeroot
Smilax hispida	Greenbrier
Vitis cinerea	Grayback grape

HERBS AND VINES OF ROADSIDES AND CLEARINGS

Common[c]

Axonopis affinis	Carpet grass
Cynodon dactylon	Bermuda grass
Diodia teres	Rough buttonweed
Eupatorium capillifolium	Dogfennel
Helenium amarum	Bitterweed
Rubus louisianus	Blackberry

Table 2.7-2 (Continued)

Species Identified at the LES Site:
Upland Mixed Forest--Several Years Since Harvest

HERBS AND VINES OF ROADSIDES AND CLEARINGS (continued)

Moderate[a]

Acalypha gracilens	Three-seeded mercury
Ambrosia artemisiifolia	Short ragweed
Conyza canadensis	Horse-weed
Croton capitatus	Doveweed
Dichanthelium scoparium	Panic grass
Dichanthelium laxiflorum	Panic grass
Digitaria ciliaris	Crab grass
Erechtites hieracifolia	Fireweed
Gnaphalium purpureum	Purple cudweed
Lespedeza striata	Japanese lespdeza
Mollugo verticillata	Carpet weed
Oxalis dillenii	Yellow wood sorrel
Rubus trivialis	Southern dewberry

Scattered[b]

Aira elegans	Hair grass
Asplenium platyneuron	Ebony spleenwort
Berchemia scandens	Rattan
Carex complanata	Sedge
Crotalaria sagittalis	Rattlepod
Dichanthelium aciculare	Panic grass
Erigeron strigosus	Daisy fleabane
Euphorbia corollata	Flowering spurge
Gelsemium sempervirens	Carolina jessamine
Hedyotis uniflora	Bluets
Heterotheca mariana	Golden aster
Juncus biflorus	Rush
Juncus nodatus	Rush
Lactuca ludoviciana	Lettuce
Lechea mucronata	Pinweed
Lespedeza cuneata	Sericea lespedeza
Monarda punctata	Spotted beebalm
Paspalum setaceum	Paspalum
Polygonum sp.	Smartweed
Rudbeckia hirta	Brown-eyed susan
Sida rhombifolia	Axocatain

Table 2.7-2 (Continued)

Species Identified at the LES Site:
Upland Mixed Forest--Several Years Since Harvest

WOODY SPECIES

Dominant[a]	
Liquidambar styraciflua	Sweetgum
Pinus taeda	Loblolly pine
Common[a]	
Acer rubrum	Red maple
Callicarpa americana	American beautyberry
Diospyros virginiana	Persimmon
Myrica cerifera	Wax myrtle
Quercus falcata	Southern red oak
Rhamnus caroliniana	Indian cherry
Rhus copallina	Winged sumac
Moderate[a]	
Carya cordiformis	Bitternut hickory
Carya tomentosa	Mockernut hickory
Cornus florida	Flowering dogwood
Fraxinus americana	White ash
Ilex opaca	American holly
Morus rubra	Red mulberry
Nyssa sylvatica	Black gum
Ostrya virginiana	Hop hornbeam
Quercus nigra	Water oak
Quercus alba	White oak
Sassafras albidum	Sassafras
Scattered[b]	
Aralia spinosa	Hercules'-club
Ascyrum hypericoides	St. Andrew's cross
Bumelia lanuginosa	Gum bumelia
Carpinus caroliniana	Blue beech
Chionanthus virginica	Fringe tree
Crataegus crus-galli	Cockspur hawthorn
Crataegus marshallii	Parsley hawthorn
Fagus grandifolia	American beech
Hamamelis virginiana	Witch hazel
Ilex decidua	Deciduous holly
Juniperus virginiana	Red cedar
Pinus echinata	Shortleaf pine

Table 2.7-2 (Continued)

Species Identified at the LES Site:
Upland Mixed Forest--Several Years Since Harvest

WOODY SPECIES (continued)

Scattered[b] (continued)

Platanus occidentalis	Sycamore
Prunus serotina	Black cherry
Quercus stellata	Post oak
Quercus phellos	Willow oak
Rhus aromatica	Fragrant sumac
Sapium sebiferum	Chinese tallow tree
Ulmus alata	Winged elm
* Vaccinium elliottii	Elliot's blueberry
Vaccinium arboreum	Farkleberry
Vaccinium amoenum	Huckleberry
Viburnum dentatum	Southern arrow-wood
Zanthoxylum clava-herculis	Pepperbark

[a] Moderate species are those that may or may not be in view at any random point within a given vegetative community but that may be located with a limited amount of searching.

[b] Scattered species are those that occur only a few times within a given vegetative community or that are abundant only in one or two localized areas.

[c] Common species are those that may be noted at any random point within a specific vegetative community.

[d] Dominant species are the most prevalent species within a given vegetative community based on considereations of biomass (qualitatively determined by number and size of individuals).

Table 2.7-3

Species Identified at the LES Site:
Upland Mixed Forest--Pine Dominated

HERBS AND VINES

Common[a]

Axonopis affinis	Carpet grass
Eupatorium capillifolium	Dogfennel

Moderate[b]

Cynodon dactylon	Bermuda grass
Diodia teres	Rough buttonweed
Helenium amarum	Bitterweed
Rubus louisianus	Blackberry
Smilax bona-nox	Catbrier

Scattered[c]

Acalypha gracilems	Three-seeded mercury
Aira elegans	Hair grass
Amaranthus viridis	Pigweed
Berchemia scandens	Rattan
Bidens sp.	Beggar ticks
Conyza canadensis	Horse-weed
Croton glandulosus	Croton
Croton capitatus	Doveweed
Gnaphalium purpureum	Purple cudweed
Hedyotis uniflora	Bluets
Juncus tenuis	Path rush
Juncus biflorus	Rush
Lechea tenuifolia	Pinweed
Lepidium virginicum	Peppergrass
Lespedeza cuneata	Sericea lespedeza
Mollugo verticillata	Carpet weed
Monarda punctata	Spotted beebalm
Oxalis dillenii	Yellow wood sorrel
Parthenocissus quinquefolia	Virginia creeper
Phytolacca americana	Poleweed
Rosa carolina	Pasture rose
Rubus trivialis	Southern dewberry
Sida rhombifolia	Axocatzin
Smilax bona-nox	Catbrier
Smilax rotundifolia	Greenbrier
Smilax glauca	Greenbrier
Solanum carolinense	Carolina horse-nettle
Spermolepis inermis	Spermolepis
Stylosanthes biflora	Pencil flower
Trigia urticifolia	Trigia

Table 2.7-3 (Continued)

Species Identified at the LES Site:
Upland Mixed Forest--Pine Dominated

WOODY SPECIES

Dominant[d]

Pinus taeda	Loblolly pine

Common[a]

Liquidambar styraciflua	Sweetgum

Moderate[b]

Callicarpa americana	American beautyberry
Diospyros virginiana	Persimmon
Nyssa sylvatica	Black gum
Rhamnus caroliniana	Indian cherry
Rhus copallina	Winged sumac

Scattered[c]

Acer rubrum	Red maple
Chionanthus virginica	Fringe tree
Fraxinus americana	White ash
Ilex opaca	American holly
Ilex vomitoria	Yaupon holly
Melia azedarach	China berry
Myrica cerifera	Wax myrtle
Ostrya virginiana	Hop hornbeam
Pinus echinata	Shortleaf pine
Prunus serotina	Black cherry
Quercus falcata	Southern red oak
Quercus nigra	Water oak
Quercus alba	White oak
Sassafras albidum	Sassafras
Ulmus alata	Winged elm

[a]Common species are those that may be noted at any random point within a specific vegetative community.
[b]Moderate species are those that may or may not be in view at any random point but that may be located with a limited amount of searching.
[c]Scattered species are those that occur only a few times within a given vegetative community or that are abundant only in one or two localized areas.
[d]Dominant species are the most prevalent species within a given vegetative community based on considerations of biomass (qualitatively determined by number and size of individuals).

Table 2.7-4

Species Identified at the LES Site: Upland Mixed Forest--Mature

HERBS AND VINES

Common[a]	
Chasmanthium sessiliflorum	Spike grass
Vitis rotundifolia	Muscadine
Moderate[b]	
Parthenocissus quinquefolia	Virginia creeper
Scattered[c]	
Erythrina herbacea	Coral bean
Gelsemium sempervirens	Carolina jessamine
Mitchella repens	Partridge berry
Pteridium aquilinum	Bracken fern
Smilax rotundifolia	Greenbrier
Smilax glauca	Greenbrier

WOODY SPECIES

Dominant[d]	
Acer rubrum	Red maple
Pinus taeda	Loblolly pine
Quercus falcata	Southern red oak
Common[a]	
Nyssa sylvatica	Black gum
Quercus alba	White oak
Quercus nigra	Water oak
Moderate[b]	
Carya cordiformis	Bitternut hickory
Chionanthus virginica	Fringe tree
Liquidambar styraciflua	Sweetgum
Prunus serotina	Black cherry
Rhamnus caroliniana	Indian cherry
Vaccinium arboreum	Farkleberry
Vaccinium elliottii	Elliott's blueberry
Viburnum dentatum	Southern arrow-wood

Table 2.7-4 (Continued)

Species Identified at the LES Site:
Upland Mixed Forest--Mature

WOODY SPECIES (continued)

Scattered[c]

Callicarpa americana	American beautyberry
Cornus florida	Flowering dogwood
Fagus grandifolia	American beech
Fraxinus americana	White ash
Sassafras albidum	Sassafras

[a]Common species are those that may be noted at any random point within a specific vegetative community.
[b]Moderate species are those that may or may not be in view at any random point but that may be located with a limited amount of searching.
[c]Scattered species are those that occur only a few times within a given vegetative community or that are abundant only in one or two localized areas.
[d]Dominant species are the most prevalent species within a given vegetative community based on considereations of biomass (qualitatively determined by number and size of individuals.

Table 2.7-5

Species Identified at the LES Site:
Bottomland Hardwood Forest

HERBS AND VINES

Common[a]

Athyrium filix-femina	Lady fern
Boehmeria cylindrica	False nettle
Lonicera japonica	Japanese honeysuckle
Lycopus rubellus	Bugle-weed
Mitchella repens	Partridge berry
Rhus toxicodendron	Poison ivy

Moderate[b]

Berchemia scandens	Rattan
Bidens sp.	Beggar ticks
Carex complanata	Sedge
Carex lurida	Sedge
Chasmanthium sessiliflorum	Spike grass
Dichanthelium dichotomum	Panic grass
Eupatorium perfoliatum	Thoroughwort
Gelsemium sempervirens	Carolina jessamine
Hypericum mutilum	St. John's-wort
Juncus brachycarpus	Rush
Juncus coriaceous	Soft rush
Ludwigia alternifolia	Seedbox
Onoclea sensibilis	Sensitive fern
Panicum hians	Panic grass
Parthenocissus quinquefolia	Virginia creeper
Polygonum sp.	Smartweed
Rhynchospora inexpansa	Beaked hornrush
Rhynchospora macrostachya	Beaked hornrush
Rubus louisianus	Blackberry
Sanicula canadensis	Black snakeroot
Smilax rotundifolia	Greenbrier
Smilax pumila	Sarsaparilla-vine
Viola primulifolia	Violet
Vitis rotundifolia	Muscadine
Woodwardia areolata	Chain fern

Scattered[c]

Ambrosia artemisiifolia	Short ragweed
Apios americana	Ground nut
Arisaema triphyllum	Jack-in-the-pulpit
Asplenium platyneuron	Ebony spleenwort
Chasmanthium laxum	Spike grass

Table 2.7-5 (Continued)

Species Identified at the LES Site:
Bottomland Hardwood Forest

HERBS AND VINES (continued)

Scattered[c] (continued)

Commelina virginica	Day-flower
Cyperus ovularis	Hedgehog club rush
Cyperus globosus	Umbrella sedge
Dichanthelium scoparium	Panic grass
Dichanthelium sphaerocarpon	Panic grass
Dichanthelium commutatum	Panic grass
Elephantopus carolinianus	Elephant's foot
Erechtites hieracifolia	Fireweed
Eryngium prostratum	Eryngium
Eupatorium serotinum	Boneset
Hedyotis uniflora	Bluets
Hydrocotyle verticillata	Water-pennywort
Hypericum walteri	St. John's-wort
Juncus tenuis	Path rush
Juncus diffusissimus	Rush
Juncus effusus	Soft rush
Lespedeza cuneata	Sericea lespedeza
Ludwigia palustris	Marsh purslane
Mimulus alata	Monkey-flower
Polystichum acrostichoides	Christmas fern
Prunella vulgaris	Self heal
Smilax hispida	Greenbrier
Viola langloisii	Violet

WOODY SPECIES

Common[a]

Acer rubrum	Red maple
Alnus serrulata	Common alder
Carpinus caroliniana	Blue beech
Liquidambar styraciflua	Sweetgum
Nyssa sylvatica	Black gum

Moderate[b]

Fagus grandifolia	American beech
Ilex opaca	American holly
Myrica heterophylla	Wax myrtle
Pinus taeda	Loblolly pine
Quercus phellos	Willow oak
Rhamnus caroliniana	Indian cherry
Ulmus alata	Winged elm
Viburnum nudum	Possum-haw

Table 2.7-5 (Continued)

Species Identified at the LES Site:
Bottomland Hardwood Forest

WOODY SPECIES (continued)

Scattered[c]

Asimina triloba	Pawpaw
Carya cordiformis	Bitternut hickory
Cephalanthus occidentalis	Buttonbush
Cornus stricta	Stiff dogwood
Diospyros virginiana	Persimmon
Hamamelis virginiana	Witch hazel
Itea virginica	Viginia willow
Ligustrum sinense	Privet
Magnolia virginiana	Sweet bay
Myrica cerifera	Wax myrtle
Ostrya virginiana	Hop hornbeam
Quercus nigra	Water oak
Salix nigra	Black willow
Sambucus canadensis	Elderberry

[a]Common species are those that may be noted at any random point within a specific vegetative community.
[b]Moderate species are those that may or may not be in view at any random point but that may be located with a limited amount of searching.
[c]Scattered species are those that occur only a few times within a given vegetative community or that are abundant only in one or two localized areas.

Table 2.7-6

Commercially Important Timber Species
Commonly Occurring at the CEC Site

Scientific Name	Common Name
Liquidambar styraciflua	Sweetgum
Fraxinus americana	White ash
Quercus spp.	Oaks
Acer rubrum	Red maple
Prunus serotina	Black cherry
Nyssa sylvatica	Black gum
Carya spp.	Hickories
Pinus taeda	Loblolly pine

Table 2.7-7

State Rare Plant Species Potentially Occurring at the LES Site

Scientific Name	Common Name	LNHP Ranking[a]
Hypoxis longii	Long's yellow star-grass	SU
Oenothera sessilis	Evening primrose	S3
Panicium clandestinum	Deer-tongue witchgrass	S1
Sanguinaria candensis	Bloodroot	S2
Trillium recurvatum	Reflexed trillium	SU

[a]Rankings assigned by the Louisiana Natural Heritage Program (Reference 4):

SU = Possibly in peril in the State but status uncertain.

S1 = Critically imperiled in the State because of extreme rarity (5 or fewer occurrences or few remaining individuals or acres) or because of other factors making it especially vulnerable to extirpation from the State.

S2 = Imperiled in the State because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because other factors making it very vulnerable to extirpation.

S3 = Rare or uncommon in State (21 to 100 occurrences).

Table 2.7-8

Distribution and Abundance of Mammals Potentially Using the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Probable Distribution and Abundance at the LES Site[c]
RODENTS	RODENTIA		
Gray squirrel	Sciurus carolinensis	Hardwood forests with nut trees, river bottoms	Possibly occurs at the site but in limited numbers due to limited availability of mature nut trees
Fox squirrel	Sciurus niger	Open forests with little understory[d]	Probably uncommon at the site given that most forest on the site are young and have relatively dense understory; could occur in the mature upland forest in western portion of site
Southern flying squirrel	Glaucomys volans	Woodlots and forests of deciduous or mixed-deciduous-coniferous trees	Possibly occurs at the site in the upland mixed forests east of Road 806 which have not been harvested recently
Beaver	Castor canadensis	Streams or lakes with trees on the banks	Known to occur at the site; distribution probably limited to the small on-site pond and Lake Avalyn; at most, site likely to support two family units since only one family will occupy a given pond or lake
Fulvous harvest mouse	Reithrodontomys fulvescens	Grasslands with scattered brush, weedy fields, fence rows	Possibly occurs at the site, but probably in limited numbers due to limited availability of suitable habitat
Cotton mouse	Peromyscus gossypinus	Wooded areas along streams or bordering fields, swampland	Possibly common along drainage ways at the site
Golden mouse	Peromyscus nuttalli	Forests, moist thickets, greenbrier	Possibly common at the site
Hispid cotton rat	Sigmodon hispidus	Tall grass, sedges and weeds, moist areas	Possibly occurs at the site but likely in limited numbers due to limited availability of suitable habitat

Table 2.7-8 (Continued)

Distribution and Abundance of Mammals Potentially Using the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Probable Distribution and Abundance at the LES Site[c]
RODENTS (cont.)	RODENTIA (cont.)		
Black rat	*Rattus rattus*	Closely associated with man and his structures	Probably uncommon at the site
Norway rat	*Rattus norvegicus*	Closely associated with man and his structures	Probably uncommon at the site
House mouse	*Mus musculus*	Closely associated with man and his structures	Probably uncommon at the site
Nutria	*Myocastor coypus*	Marshes, swamps, ponds, lakes	Probably uncommon or absent from the site; this species is uncommon in northern Louisiana[d]
CARNIVORES	CARNIVORA		
Gray fox	*Urocyon cinereoargenteus*	Mixed hardwood stands with interspersed fields[e]	May occur at the site; based on considerations of typical homerange size (190-400 acres[f]), the site probably can support only 1 or 2 foxes
Coyote	*Canis latraus*	Prairies, open woodlands, brushy or boulder-strewn areas	This species is common in northern Louisiana[d] and probably forages on the site; however, because of its large foraging area (up to 24 mi^2[g]), it probably occurs only occasionally on the site
Raccoon	*Procyon lotor*	Streams and lakes near wooded areas or rock cliffs	Known to occur at the site; will be limited to areas near on-site pond and lake and in bottomlands along drainage ways; based on consideration of typical population densities (1 raccoon/20 acres[h]), and habitat availability, the site probably supports less than 5 raccoons

Table 2.7-8 (Continued)

Distribution and Abundance of Mammals Potentially Using the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Probable Distribution and Abundance at the LES Site[c]
CARNIVORES (cont.)			
Mink	Mustela vison	Streams and lake borders	Possibly occurs on the site in bottomlands and along drainage ways; because of its large foraging area (up to 3.5 miles along streams), this species probably occurs only occasionally on the site
Striped skunk	Mephitis mephitis	Semi-open country; mixed woods, brushland, prairie	Probably common in upland habitats at the site; population densities up to 1 skunk/10 acres are possible in good habitat
River otter	Lutra canadensis	Rivers and the lakes and tributaries that feed them	Probably does not occur at the site
Bobcat	Lynx rufus	Swamps and forest	Possibly occurs at the site; however, because of its large foraging area (0.6 to 3 mi^2 in Louisiana), probably only occasionally occurs on the site
INSECTIVORES	INSECTIVORA		
Least shrew	Cryptotis parva	Open grassy areas that may have brush, marshes	Likely to occur at the site; probably most common in woodland pastures east of Road 806, which have grassy clearings; population densities up to 25 shrews/acre have been reported for some shrew species
Eastern mole	Scalopus aquaticus	Sandy loam areas in fields, lawns, meadows	Probably uncommon at the site due to a lack of suitable habitat
BATS	CHIROPTERA		
Southeastern myotis	Myotis austroriparius	Caves, hollow trees, man-made structures	Probably uncommon or absent at the site due to limited availability of suitable habitat

Table 2.7-8 (Continued)

Distribution and Abundance of Mammals Potentially Using the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Probable Distribution and Abundance at the LES Site[c]
BATS (cont'd)			
Eastern pipistrel	Pipistrellus subflavus	Caves, tunnels, buildings, wooded areas	Probably uncommon at site due to limited availability of suitable habitat; could occur to some extent in forested areas
Red bat	Lasiurus borealis	Wooded areas	Could occur in forested areas of the site
Evening bat	Nycticeius humeralis	Buildings, hollow trees	Probably uncommon or absent at the site due to a lack of suitable habitat
Rafinesque's big-eared bat	Plecotus rafinesquei	Caves, mine tunnels, buildings	Probably absent from the site due to a lack of suitable habitat
ARMADILLOS	XENARTHA		
Nine-banded armadillo	Dasypus novemcinctus	Woodlands, brushy areas, rock outcrops	Probably occurs in upland habitats at the site; typical population densities are 1 armadillo per 3 to 10 acres
RABBITS	LAGOMORPHA		
Eastern cottontail	Silvilagus floridanus	Heavy brush est strips with open areas nearby, weed patches, swamp edges	Possibly common at the site, particularly in recently forested areas in the western portions of the site and east of Lake Avalyn; typical population densities range between 1 and <8 cottontails/acre
Swamp rabbit	Silvilagus aquaticus	Swamps, marshes, wet bottomlands	Probably absent from the site; typically, large tracts of wetlands (>250 acres) are required to support populations of this species

Table 2.7-8 (Continued)

Distribution and Abundance of Mammals Potentially Using the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Probable Distribution and Abundance at the LES Site[c]
POUCHED MAMMALS	MARSUPIALIA		
Opossum	*Didelphis marsupialis*	Farming areas, woodlots, along streams	Probably occurs at the site along drainage ways and in pasture areas east of Road 806; site probably does not support a large number of opossum, given that there are few streams on the site and a typical home range area is 15-30 acres[m]
HOOFED MAMMALS	ARTIODACTYLA		
Whitetailed deer	*Odocoileus virginianus*	Forest, swamps, and open brushy areas	Known to occur at the site; probably in all habitats; assuming a carrying capacity of 1 deer per 50 acres for northwest Louisiana forests[n], the LES site could support approximately 10 deer

[a]Species listed are those identified by the Louisiana Natural Heritage Program as occurring in the general site area (Reference 4).
[b]Except as noted, (Reference 16).
[c]Estimated.
[d](Reference 25).
[e](Reference 10).
[f](Reference 26).
[g](Reference 27).
[h](Reference 19).
[i](Reference 28).
[j](Reference 29).
[k](Reference 30).
[l](Reference 18).
[m](Reference 31).
[n](Reference 14).

Table 2.7-9

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
GREBES	PODICIPEDAE					
Pied-billed grebe	Podilymbus podiceps				X	X
CORMORANTS	PHALACROCORACIDAE					
Double-crested cormorant	Phalacrocorax auritus	X				X
HERONS, EGRETS AND BITTERNS	ARDEIDAE					
Great blue heron	Ardea herodias	X		X	X	
Great egret	Casmerodius albus			X		X
Snowy egret	Egretta thula			X	X	
Little blue heron	Egretta caerulea	X		X		
Tricolored heron	Egretta tricolor			X	X	
Cattle egret	Bubulcus ibis			X	X	
Green-backed heron	Butorides striatus	X	X	X		
Black-crowned night heron	Nycticorax nycticorax		X	X		
Yellow-crowned night heron	Nycticorox violaceus		X	X		
DUCKS, SWANS, GEESE	ANATIDAE					
Wood duck	Aix sponsa	X	X	X	X	
Green-winged teal	Anas crecca				X	X
Mallard	Anas platyrhynchos				X	X

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name: Common Name	Species Name: Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Potential Use Including Those Verified: Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
DUCKS, SWANS, GEESE (cont'd)						
Northern pintail	Anas acuta				X	X
Blue-winged teal	Anas discors					X
Northern shoveler	Anas clypeata				X	X
Gadwall	Anas strepera				X	X
American widgeon	Anas americana				X	X
Ring-necked duck	Aythya collaris				X	X
Hooded merganser	Lophodytes cucullatus		X	X	X	
VULTURES	CATHARTIDAE					
Black vulture	Coragyps atratus		X	X	X	
Turkey vulture	Cathartes aura	X	X	X	X	
OSPREYS, KITES, EAGLES AND HAWKS	ACCIPITRIDAE					
Northern harrier	Circus cyaneus				X	X
Sharp-shinned hawk	Accipiter striatus		X	X	X	
Cooper's hawk	Accipiter cooperii		X	X	X	
Red-shouldered hawk	Buteo lineatus	X	X	X	X	
Broad-winged hawk	Buteo platypterus	X	X	X		
Red-tailed hawk	Buteo jamaicensis	X	X	X	X	

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
CARACARAS AND FALCONS	FALCONIDAE					
American kestrel	*Falco sparverius*		X	X	X	
PARTRIDGE, PHEASANT, GROUSE, TURKEY, QUAIL	PHASIANIDAE					
Wild turkey	*Meleagris gallopavo*		X	X	X	
Northern bobwhite	*Colinus virginianus*	X	X	X	X	
RAILS	RALLIDAE					
American coot	*Fulica americana*				X	X
PLOVERS	CHARADRIIDAE					
Killdeer	*Charadrius vociferus*		X	X	X	
SANDPIPERS, PHALAROPES AND ALLIES	SCOLOPACIDAE					
Common snipe	*Gallinago gallinago*				X	X
American woodcock	*Scolopax minor*		X	X	X	X

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	...ster	Summer Resident	Winter Resident	Spring-Fall Migrant
PIGEONS AND DOVES	COLUMBIDAE					
Mourning dove	*Zeinada macroura*		X	X	X	
CUCKOOS AND ALLIES	CUCULIDAE					
Black-billed cuckoo	*Coccyzus erythropthalmus*					X
Yellow-billed cuckoo	*Coccyzus americanus*	X	X	X		X
Greater roadrunner	*Geococcyx californianus*		X	X	X	
BARN OWLS	TYTONIDAE					
Common barn owl	*Tyto alba*				X	
COMMON OWLS	STRIGIDAE					
Eastern screech owl	*Otus asio*		X	X	X	
Barred owl	*Strix varia*		X	X	X	
NIGHTHAWKS AND POORWILLS	CARPRIMULGIDAE					
Common nighthawk	*Chordeiles acutipennis*		X	X		
Chuck-will's widow	*Caprimulgus carolineusis*		X	X		
Whip-poor-will	*Caprimulgus vociferus*					X

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
SWIFTS	APODIDAE					
Chimney swift	Chaetura pelagica			X		
HUMMINGBIRDS	TROCHILIDAE					
Ruby-throated hummingbird	Archiloches colubris		X	X		X
KINGFISHERS	ALCEDINIDAE					
Belted kingfisher	Ceryle alcyon	X		X	X	
WOODPECKERS	PICIDAE					
Red-headed woodpecker	Melanerpes erythrocephalus		X	X	X	
Red-bellied woodpecker	Melanerpes carolinus	X	X	X	X	
Yellow-bellied sapsucker	Sphyrapicus varius	X			X	
Downy woodpecker	Picoides pubescens	X	X	X	X	
Hairy woodpecker	Picoides villosus	X	X	X	X	
Red-cockaded woodpecker	Picoides borealis				X	
Northern flicker	Colaptes auratus	X	X	X	X	
Pileated woodpecker	Dryocopus pileatus	X	X	X	X	

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
TYRANT FLYCATCHERS	TRYANNIDAE					
Olive-sided flycatcher	Contopus borealis					X
Eastern wood pewee	Contopus virens	X	X	X		X
Yellow-bellied flycatcher	Empidonax flaviventris					X
Acadian flycatcher	Empidonax virescens		X	X		
Alder flycatcher	Empidonax alnorum					X
Willow flycatcher	Empidonax traillii					X
Least flycatcher	Empidonax minimus					X
Eastern phoebe	Sayornis phoebe	X			X	
Great crested flycatcher	Myiarchus crinitus	X	X	X		
Eastern kingbird	Tyrannus tyrannus		X	X		
Scissor-tailed flycatcher	Tyrannus forficatus		X	X		
SWALLOWS	HIRUNDINIDAE					
Purple martin	Progne subis	X	X	X		
Tree swallow	Tachycineta bicolor					X
Northern rough-winged swallow	Stelgidopteryx serripennis			X		
Bank swallow	Riparia riparia					X
Cliff swallow	Petrochelidon pyrrhonota					X
Barn swallow	Hirundo rustica	X		X		X

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
JAYS AND CROWS	CORVIDAE					
Blue jay	Cyanocitta cristata	X	X	X	X	
American crow	Corvus brachyrhynchos	X	X	X	X	
Fish crow	Corvus ossifragus			X	X	
TITMICE	PARIDAE					
Carolina chickadee	Parus carolinensis	X	X	X	X	
Tufted titmouse	Parus bicolor	X	X	X	X	
NUTHATCHES	SITTIDAE					
Red-breasted nuthatch	Sitta canadensis				X	
White-breasted nuthatch	Sitta carolinensis			X		
Brown-headed nuthatch	Sitta pusilla	X	X	X	X	
CREEPERS	CERTHIIDAE					
Brown creeper	Certhia americana				X	

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
WRENS	TROGLODYTIDAE					
Carolina wren	Thryothorus ludovicianus	X	X	X	X	
House wren	Troglodytes aedon					X
Winter wren	Troglodytes troglodytes	X			X	
Marsh wren	Cistothorus palustris			X	X	
KINGLETS, GNATCATCHERS, THRUSHES AND ALLIES	MUSCICAPIDAE					
Golden-crowned kinglet	Regulus satrapa	X			X	
Ruby-crowned kinglet	Regulus calendula	X			X	
Blue-gray gnatcatcher	Polioptila caerulea		X	X		
Eastern bluebird	Sialia sialis	X	X	X	X	
Veery	Catharus fuscescens					X
Gray-cheeked thrush	Catharus minimus					X
Swainson's thrush	Catharus ustulatus					X
Hermit thrush	Catharus guttatus	X			X	
Wood thrush	Hylocichla mustelina		X	X		X
American robin	Turdus migratorius	X	X	X	X	

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
CATBIRDS, MOCKINGBIRDS AND THRASHERS	MIMIDAE					
Gray catbird	Dometella carolinensis	X	X	X		X
Northern mockingbird	Mimus polyglottos	X	X	X	X	
Brown thrasher	Toxostoma rufum	X	X	X	X	
WAXWINGS	BOMBYCILLIDAE					
Cedar waxwing	Bombycilla cedrorum				X	
SHRIKES	LANIIDAE					
Loggerhead shrike	Lanius ludovicianus		X	X	X	
STARLINGS AND ALLIES	STURNIDAE					
European starling	Sturnus vulgaris		X	X	X	
VIREOS	VIREONIDAE					
White-eyed vireo	Vireo griseus	X	X	X		
Solitary vireo	Vireo solitarius				X	X
Yellow-throated vireo	Vireo flavifrons		X	X		
Warbling vireo	Vireo gilvus		X	X		

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
VIREOS (cont'd)						
Philadelphia vireo	Vireo philadelphicus					X
Red-eyed vireo	Vireo olivaceus	X	X	X		
WOOD-WARBLERS, TANAGERS, CARDINALS, GROSBEAKS, BUNTINGS, SPARROWS, BLACKBIRDS, AND ORIOLES	EMBERIZIDAE					
Blue-winged warbler	Vermivora pinus					X
Golden-winged warbler	Vermivora chrysoptera					X
Tennessee warbler	Vermivora peregrina					X
Orange-crowned warbler	Vermivora celata				X	
Nashville warbler	Vermivora ruficapilla					X
Northern parula	Parula americana			X		
Yellow warbler	Dendroica petechia					X
Chestnut-sided warbler	Dendroica pensylvanica					X
Magnolia warbler	Dendroica magnolia					X
Cape May Warbler	Dendroica tigrina					X
Black-throated blue warbler	Dendroica caerulescens					X
Yellow-rumped warbler	Dendroica coronata	X			X	
Black-throated green warbler	Dendroica virens					X

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
WOOD-WARBLERS, TANAGERS, CARDINALS, GROSBEAKS, BUNTINGS, SPARROWS, BLACKBIRDS, AND ORIOLES (cont.)	EMBERIZIDAE (cont.)					
Blackburnian warbler	Dendroica fusca					X
Yellow-throated warbler	Dendroica dominica		X	X		
Pine warbler	Dendroica pinus	X	X	X	X	
Prairie warbler	Dendroica discolor	X	X	X		
Palm warbler	Dendroica palmarum					X
Bay-breasted warbler	Dendroica castanea					X
Blackpoll warbler	Dendroica striata					X
Cerulean warbler	Dendroica cerulea					X
Black-and-white warbler	Mniotilta varia		X	X		X
American redstart	Setophaga ruticilla		X	X		X
Prothonotary warbler	Protonotaria citrea	X	X	X		
Worm-eating warbler	Helmitheros vermivorus	X				X
Swainson's warbler	Limnothlypis swainsonii			X		
Ovenbird	Seiurus aurocapillus					X
Northern waterthrush	Seiurus noveboracensis					X
Louisiana waterthrush	Seiurus motacilla		X	X		
Kentucky warbler	Oporornis formosus		X	X		
Common yellowthroat	Geothlypis trichas	X	X	X	X	
Hooded warbler	Wilsonia citrina	X	X	X		
Wilson's warbler	Wilsonia pusilla					X

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
WOOD-WARBLERS, TANAGERS, CARDINALS, GROSBEAKS, BUNTINGS, SPARROWS, BLACKBIRDS, AND ORIOLES (cont.)	EMBERIZIDAE (cont.)					
Canada warbler	Wilsonia camadensis					X
Yellow-breasted chat	Icteria virens	X	X	X		
Summer tanager	Piranga rubra	X	X	X		
Scarlet tanager	Piranga olivacea					X
Northern cardinal	Cardinalis cardinalis	X	X	X	X	
Rose-breasted grosbeak	Pheuctucus ludovicianus					X
Black-headed grosbeak	Pheucticus melanocephalus				X	
Blue grosbeak	Guiraca caerulea	X	X	X		
Indigo bunting	Passerina cyanea	X	X	X		
Painted bunting	Passerina ciris		X	X		
Dickcissel	Spiza americana			X		X
Rufous-sided towhee	Pipilo erythrophthalmus	X			X	
Chipping sparrow	Spizella passerina	X	X	X	X	
Field sparrow	Spizella pusilla	X			X	
Vesper sparrow	Pooecetes gramineus				X	
Lark sparrow	Chondestes grammacus		X	X		
Savannah sparrow	Passerculus sandwichensis				X	
Henslow's sparrow	Ammodramus henslowii				X	
Le Conte's sparrow	Ammondramus leconteii				X	

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
WOOD-WARBLERS, TANAGERS, CARDINALS, GROSBEAKS, BUNTINGS, SPARROWS, BLACKBIRDS, AND ORIOLES (cont.)	EMBERIZIDAE (cont.)					
Fox sparrow	Passerella iliaca				X	
Song sparrow	Melospiza melodia	X			X	
Lincoln's sparrow	Melospiza lincolnii	X			X	
Swamp sparrow	Melospiza georgiana	X			X	
White-throated sparrow	Zonotrichia albicollis	X			X	
Dark-eyed junco	Junco hyemalis	X			X	
Red-winged blackbird	Ageiaius phoeniceus	X	X	X	X	X
Eastern meadowlark	Sturnella magna			X	X	
Rusty blackbird	Euphagus carolinus				X	
Brewer's blackbird	Euphagus cyanocephalus				X	
Common grackle	Quiscalus quiscula			X	X	
Brown-headed cowbird	Molothrus ater	X	X	X	X	
Orchard oriole	Icterus spurius	X	X	X		
Northern oriole	Icterus galbula		X	X		

Table 2.7-9 (Continued)

Birds That May Potentially Exist on the LES Site

Species Name			Potential Use Including Those Verified			
Common Name	Scientific Name	Seen or Heard on on Avian Surveys in January and April 1990	Nester	Summer Resident	Winter Resident	Spring-Fall Migrant
FINCHES AND ALLIES	FRINGILLIDAE					
Purple finch	Carpodacus purpureus	X			X	
Pine siskin	Carduelis pinus				X	
American goldfinch	Carduelis tristis	X			X	

Table 2.7-10

Amphibians and Reptiles Potentially Occurring on the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Possible Distribution at the LES Site[c]
AMPHIBIANS			
Spotted salamander	Ambystoma maculatum	Moist woods; breeds in woodland ponds	Bottomlands, onsite pond, Lake Avalyn
Marbled salamander	Ambystoma opacum	Variety of habitats	Possibly site wide
Northern dusky salamander	Desmognathus fuscus fuscus	Woodland streams, springs	Along streams
Dwarf salamander	Eurycea quadridigitata	Low, swampy areas	Bottomlands, pond and lake edge
Northern cricket frog	Acris crepitans crepitans	Near permanent bodies of water with vegetation	Near onsite pond and Lake Avalyn
Woodhouse's toad	Bufo woodhousei woodhousei	Shores of small lakes	Lake Avalyn shoreline
Eastern narrowmouth toad	Gastrophryne carolinensis	Sheltered, moist areas, water edge	Bottomlands, pond and lake edge
Cope's gray treefrog	Hyla chrysoscelis	Breeds in standing bodies of water	Pond and lake edge (breeding)
Green treefrog	Hyla cinerea	Swamps, lake borders, streams	Bottomlands, pond and lake edge, along streams
Upland chorus frog	Pseudacris triseriata feriarum	Moist woods, bottomlands	Bottomlands
Bullfrog	Rana catesbeiana	Lakes, ponds, bogs	Onsite pond, Lake Avalyn
Bronze frog	Rana clamitans	Swamps, near streams	Bottomlands, stream edges
Southern leopard frog	Rana sphenocephala	Shallow, fresh water with vegetation	Shallow portions of onsite pond and Lake Avalyn
REPTILES			
Common snapping turtle	Chelydra serpentina serpentina	Permanent fresh water	Onsite pond, Lake Avalyn
Red-eared slider	Chrysemys scripta elegans	Quiet waters with muddy bottoms	Onsite pond, Lake Avalyn

Table 2.7-10 (Continued)

Amphibians and Reptiles Potentially Occurring on the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Possible Distribution at the LES Site[c]
REPTILES (cont.)			
Mississippi map turtle	Graptemys kohni	Large bodies of water	Lake Avalyn
Eastern mud turtle	Kinosternon subrubrum subrubrum	Shallow water of small ponds	Onsite pond
Stinkpot	Sternotherus odoratus	Lakes, ponds, rivers	Onsite pond, Lake Avalyn
Texas spiny softshell	Trinoyx spiniferus emoryi	Permanent streams	Streams
American alligator	Alligator mississippiensis	Large rivers, swamps, bayous	Probably does not occur at the site
Northern fence lizard	Sceloporus undulatus hyacinthinus	Forests, open pine forest	Possibly site wide; may be more abundant in upland pine forest
Ground skink	Scincella lateralis	Woodlands	Possibly site wide
Six-lined racerunner	Cnemidophorus sexlineatus sexlineatus	Open, well-drained areas	Recently timbered areas
Southern coal skink	Eumeces anthracinus pluvialis	Humid portions of wooded hillsides	Upland mixed and pine forests
Five-lined skink	Eumeces fasciatus	Cutover woodlots	Recently timbered areas
Southern copperhead	Agkistrodon contortrix contortrix	Lowlands	Bottomlands
Western cottonmouth	Agkistrodon piscivorus leucostoma	Swamps and bayous	Possibly onsite pond and lake
Northern scarlet snake	Cemophora coccinea copei	Areas with sandy, loamy soil	Sandy, loamy soil areas
Buttermilk racer	Coluber constrictor anthicus	Open fields, forest edge	Open areas in woodland pastures
Western pygmy rattlesnake	Sistrurus miliaris	River floodplain, swamps, marshes	Bottomlands

Table 2.7-10 (Continued)

Amphibians and Reptiles Potentially Occurring on the LES Site[a]

Common Name	Scientific Name	Preferred Habitat[b]	Probable Distribution at the LES Site[c]
REPTILES (cont.)			
Mississippi ringneck snake	Diadophis punctatus stictogenys	Swamps, springs, damp hill-sides	Bottomlands
Eastern hognose snake	Heterodon platyrhinos	Sandy areas	Sandy areas
Prairie kingsnake	Lampropeltis calligaster calligaster	Grassland, prairie, open woodlands	Open areas in woodland pastures
Diamondback water snake	Nerodia rhombifera	Variety of aquatic habitats	Onsite pond, Lake Avalyn
Northern brown snake	Storeria dekayi dekayi	Bogs, swamps, marshes, moist woodlands	Bottomlands
Northern redbelly snake	Storeria occipitomaculata occipitomaculata	In or near open woods	Woodland pastures
Flathead snake	Tantilla gracilis	Under rocks	Possibly site wide
Western ribbon snake	Thamnophis proximus proximus	Near streams and ditches, lake and pond edge	Onsite pond and Lake Avalyn edge, near streams

[a](Reference 4)
[b](Reference 32)
[c]Estimated.

Table 2.7-11

Federally Endangered Wildlife Species Whose Known or Historic Distribution Encompasses the LES Site

Scientific Name	Common Name
Campephilus pricipalis	Ivory-billed woodpecker
Felis concolorcoryi	Florida panther
Haliaeetus leucocephalus	Bald eagle
Numenius borealis	Eskimo curlew
Picoides borealis	Red-cockaded woodpecker
Vermivora bachmanii	Bachman's warbler

(Reference 4)

Table 2.7-12

Recreationally or Commercially Important Wildlife Species Potentially Occurring on the LZS Site

	Game Species
	Whitetailed deer
	Eastern cottontail
	Gray squirrel
	Fox squirrel
	Wild turkey
	Bobwhite quail
	Mourning dove
	American woodcock
	Fur Animals
	Mink
	Raccoon
	Beaver
	Skunk
	Oppossum
	Nutria
	Coyote
	Fox
	Bobcat

(Reference 10, 11)

Table ?.7-13

Plant Species Used as Deer Food Northwest Louisiana[a]

Common Name	Scientific Name	Usage and Palatability[b]	Abundance at LES Site[c]
WOODY SPROUTS AND YOUNG TREES			
American beech	*Fagus grandifolia*	H-M	M-S
White oak	*Quercus alba*	M-L	C-S
Southern red oak	*Quercus falcata*	M-L	D-S
Water oak	*Quercus nigra*	M	C-S
Elm	*Ulmus americana*	M	NP
Magnolia	*Magnolia grandiflora*	H-L	NP
Sweetbay	*Magnolia virginiana*	M	S
Blue beech	*Carpinus caroliniana*	H-M	C-S
Red maple	*Acer rubrun*	M	D-S
SMALLER TREES AND SHRUBS			
Alder	*Alnus rugosa*	L	NP
Arrow-wood	*Viburnum dentatum*	H	M-S
Azalea	*Rhododendron canescess*	H-M	NP
Cherry	*Prunus serotina*	H-M	M-S
Chokeberry	*Aronia arbutifolia*	U	NP
Dogwood	*Cornus florida*	U	M-S
Hawthorn, green	*Crataegus viridis*	U	NP
Hawthorn, parsley	*Crataegus marshalii*	U	S
Holly, decidious	*Ilex decidua*	H	S
Sweetleaf	*Symplocus tinctoria*	M	NP
Huckleberry, spring	*Vaccinum eleodia*	H	NP
Farkleberry	*Vaccinum arboreum*	M	M-S
Waxmyrtle	*Myrica cerifera*	M-R	C-S
Plum	*Prunus americana*	H	NP

Table 2.7-13 (Continued)

Plant Species Used as Deer Food Northwest Louisiana[a]

Common Name	Scientific Name	Usage and Palatability[b]	Abundance at LES Site[c]
SMALLER TREES AND SHRUBS (Cont.)			
Redbay	*Persea borbonia*	U	NP
Redbud	*Cercis canadensis*	U	NP
Silverbell	*Halesia diptera*	M-L	NP
Snowbell	*Styrax americana*	U	NP
Virginia willow	*Itea virginica*	U	S
Witch hazel	*Hamemelis virginiana*	M-L	M-S
Yaupon	*Ilex vomitoria*	H	S
VINES			
Blackberry/Dewberry	*Rubus* spp.	M-L	C-S
Smilax	*Smilax* spp.	H	M-S
Rattan	*Berchemia scandens*	H	M-S
FRUITS			
Acorns	*Quercus* spp.	H	D-S
Blackberries/Dewberries	*Rubus* spp.	H	C-S

[a](Reference 14)
[b]H = palatability high; M = palatability medium; L = palatibility low; H-L or H-M = Indicates palatiblity varies as indicated at different time of the year; U = usage and palatability unknown.
[c]D = Dominant; C = Common; M = Moderate; S = Scattered; NP = Not known to be present on the site. See Section 2.7.1.

Table 2.7-14

Macrophytes and Phytoplankton Occurring in Bluegill Pond and/or Lake Avalyn at the LES Site

Scientific Name	Common Name
Macrophytes	
Polygonium sp.	Smartweed
Zannichellia palustris	Horned pondweed
Ludwigia palustris	Marsh purslane
Juncus repens	Rush
Juncus effusus	Soft rush
Alnus serrulata	Common alder
Cephalanthus occidentalis	Buttonbush
Hypericum walteri	St. John's-wort
Utricularia sp.	Bladder wort
Liquidambar styraciflua	Sweetgum
Lycopus rubellus	Bugle-weed
Phytoplanton	
Chlorophyta	Green algae
Filementous	
Unicellular	
Desmidiaceae	
Pyrrhophyta	Dinoflagellates
Dinophyceae	
Chrysophyta	Yellow-green algae
Dinobryaceae	
Synuraceae	
Diatomaceae	

Table 2.7-15

Aquatic Invertebrates That May Occur in Bluegill Pond and Lake Avalyn

Scientific Name	Common Name
Benthic Macroinvertebrates	
Platyhelminthes	Flatworms
Planariidae	Planaria
Nematoda	Round worms
Annelida	Segmented worms
Arthropoda	
Amphipoda	
Taltridae	Side swimmers
Decapoda	
Astacidae	Crayfish
Palaemonidae	Shrimp
Insecta	
Ephemerophtera	Mayflies
Odonata	Dragonflies and Damselflies
Megaloptera	Alderflies
Tricoptera	Caddisflies
Lepidoptera	Moths
Coleoptera	Beetles
Diptera	Flies, Midges
Hemiptera	True bugs
Mollusca	
Gastropoda	Snails, Limpets
Zooplankton	
Protozoa (ciliates)	
Rotataria	
Copepoda	
Cladocera	

Table 2.7-16

Fish Species That May Occur in Bluegill Pond and Lake Avalyn

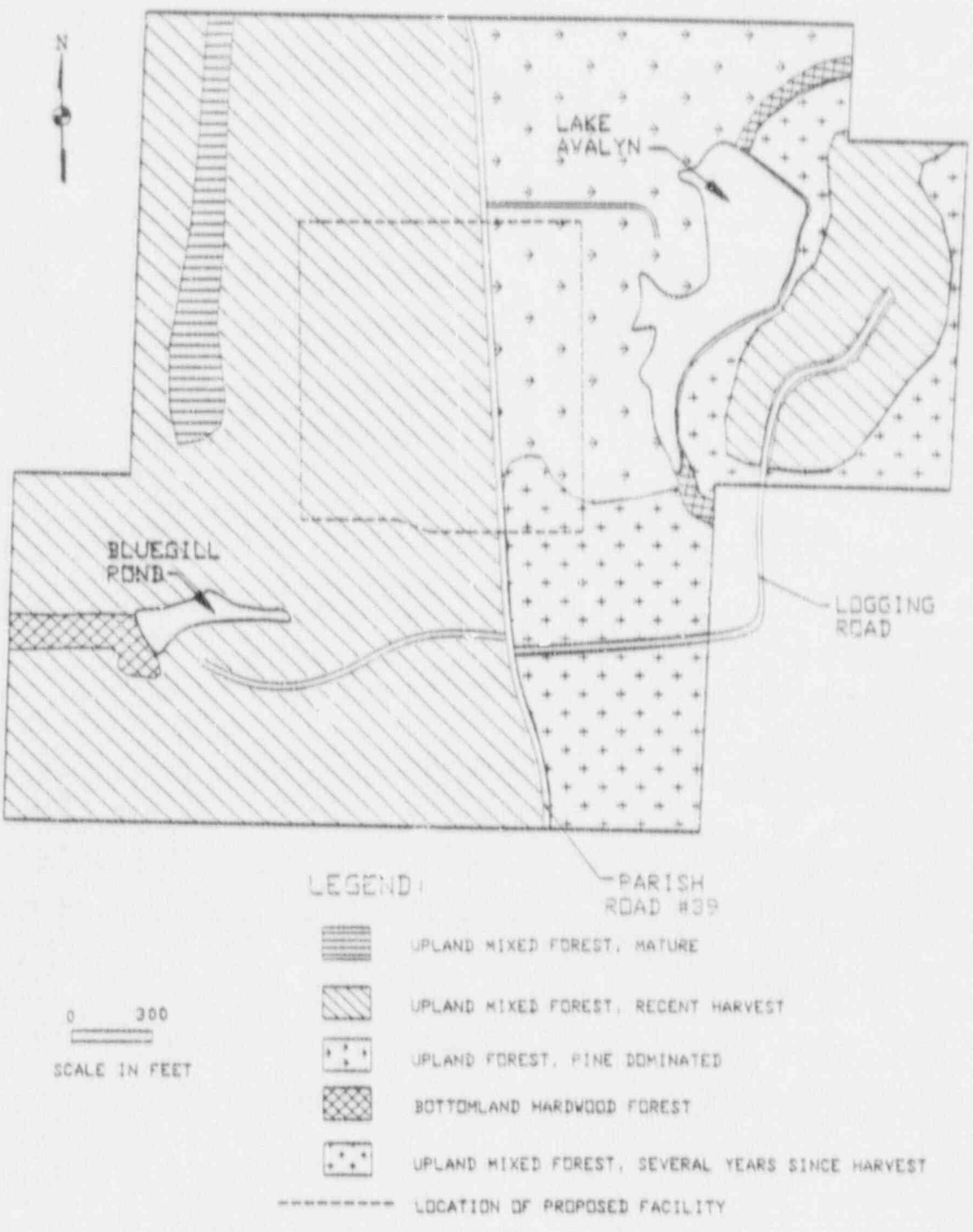
Scientific Name	Common Name
Amiidae	
Amia calva	Bowfin
Antherinidae	
* *Labidesthes sicculus*	Brook silverside
Catostomidae	
Ictiobus bubalus	Smallmouth buffalo
Ictiobus cyprinellus	Bigmouth buffalo
Ictiobus niger	Black buffalo
* *Erimyzan sucetta*	Lake chubsucker
Minytrema melanops	Spotted sucker
Centrarchidae	
Lepomis megalotis	Longear Sunfish
* *Lepomis macrochirus*	Bluegill
* *Lepomis gulosus*	Warmouth
* *Lepomis microlephus*	Readear sunfish
Lepomis punctatus	Spotted sunfish
Lepomis cyanellus	Green sunfish
* *Lepomis marginatus*	Dollar sunfish
* *Lepomis symmetricus*	Bantam sunfish
Micropterus salmoides	Largemouth bass
Micropterus salmoides floridanus	Florida largemouth bass
Micropterus punctulatus	Spotted bass
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie
Cyprinidae	
Cyprinus carpio	Common carp
Notemigonus crysoleucas	Golden shiner
Dorosoma cepedianum	Gizzard shad
Dorosoma petenense	Threadin shad
Cyprinodontidae	
* *Fundulus chrysotus*	Golden topminnow
Esocidae	
* *Esox niger*	Chain pickerel

Table 2.7-16 (Continued)

Fish Species That May Occur in Bluegill Pond and Lake Avalyn

Scientific Name	Common Name
Ictaluridae	
Ictalurus natalis	Yellow bullhead
Ictalurus melas	Black bullhead
Ictalurus nebulosus	Brown bullhead
Ictalurus furcatus	Blue catfish
Ictalurus punctatus	Channel catfish
Pylodictis olivaris	Flathead catfish
Lepisosteidae	
Lepisosteus oculatus	Spotted gar
Atractosteus spatula	Alligator gar
Lepisosteus osseus	Longnose gar
Pecidae	
Etheostoma gracile	Slough darter
Poeciliidae	
* *Gambusia affinis*	Mosquitofish

* = Species identified in the on-site pond or Lake Avalyn during the on-site survey in January 1990.



LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Principal Vegetative Communities of the LES Site

Figure 2.7-1

Louisiana Energy Services
Environmental Report
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3.0 INTRODUCTION

The Louisiana Energy Services (LES) Claiborne Enrichment Center (CEC) will be located near Homer, Louisiana in the northwest part of the state. This facility is designed to enrich natural uranium for use in commercial nuclear power plants.

The LES Claiborne Enrichment Center is focused on a uranium hexafluoride (UF6) Separations Building, which contains three practically identical plant units, a common area of shared systems, and a central control room. Other major facilities on site include a Centrifuge Assembly Building, Office Building, Guard House, Cylinder Receipt and Dispatch Building, Diesel Generator Building, a Product and Feed Storage Area, and a Tails Storage Area.

The feed material for the enrichment process at the LES facility is uranium hexafluoride with a natural composition of isotopes U-234, U-235, and U-238. A summary of its characteristics is provided in Table 3.2-2, Radiological Characteristics of Natural UF6 Feed, Table 3.2-3, Properties of UF6, and Table 3.2-4, Chemical Reaction Properties.

When mined, uranium ore contains about 0.14% uranium oxide, U3O8. When it is milled into "yellow cake", this uranium intermediate contains about 0.7 wt% U-235. A conversion plant adds fluorine to the yellow cake, creating uranium hexafluoride.

The LES facility utilizes UF6 because it is the only uranium compound having a vapor pressure suited to the centrifuge enrichment process and because fluorine is monoisotopic. The LES facility will produce UF6 enriched in a range up to 5 wt%, U-235.

The LES enrichment process is a mechanical separation of isotopes. No chemical or nuclear conversions take place. The feed, product, and tails streams are all in the form of uranium hexafluoride.

In the separation process, the hexafluoride compounds of uranium isotopes U-235 and U-238 are separated in a fast rotating cylinder (rotor) based on a difference in centrifugal forces due to differences in molecular weight of uranic isotopes.

Natural uranium feed, in the form of UF6 will be transported to the LES facility from either of two conversion facilities operating in the United States: one near Metropolis, Illinois; the other near Gore, Oklahoma. In the future, U.S. utilities may procure UF6 from anywhere in the world (e.g., Cogema in France, British Nuclear Fuels in the UK, or from Technabsexport in the Soviet Union). This natural UF6 feed arrives at the CEC as a solid under partial vacuum in 48 inch diameter transportation cylinders.

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3.1 EXTERNAL APPEARANCE

The LES enrichment facility is located in the area shown on Figure 1.1-1. The facility consists of the following buildings and storage areas: separations building, centrifuge assembly building, container receipt building, product storage area, office building, feed storage area, tails storage area and switch yard. The total area occupied within the security fence is approximately 70 acres.

The facility layout, security boundary/fence and LES owned property are illustrated on the site plan shown in Figures 3.1-1 and 3.1-2.

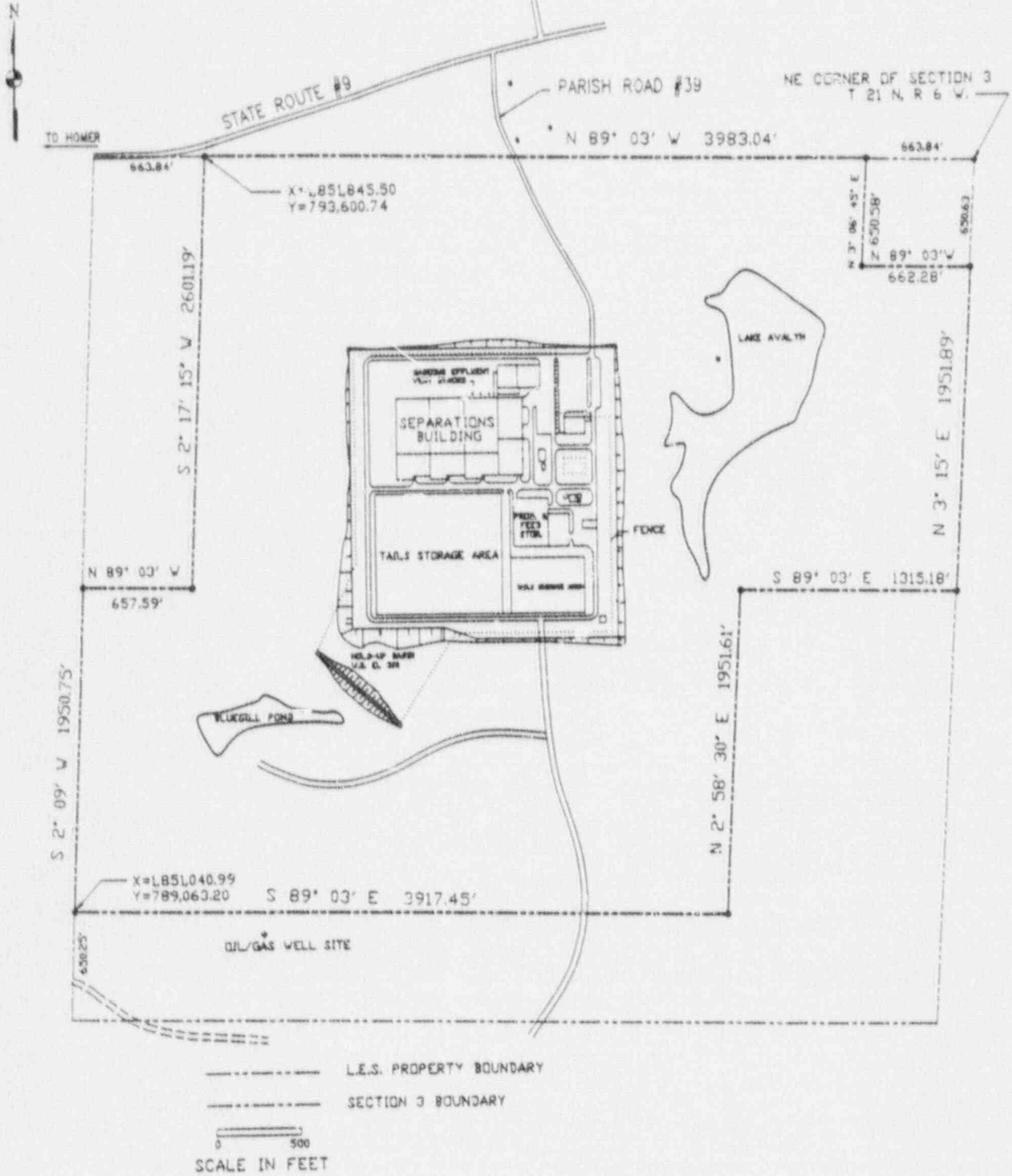
The architectural design of the facility's buildings incorporates various materials with contemporary design to create an aesthetically pleasing appearance. The Separations Building will be constructed of reinforced concrete framing with architectural masonry siding. The other buildings will be of structural steel type framing with architectural masonry siding. The buildings will vary in size and height with the tallest being the equivalent of four stories high.

Care is exercised to effectively coordinate building materials and color selections in the overall design development of the facility to provide an aesthetically pleasing effect.

Landscaping is planned for the site, areas adjacent to the structures and in the parking areas to complement and blend with the natural surroundings. Landscaping materials used are mostly those which occur naturally in the region.

The location and elevation of release points for liquid and gaseous wastes are shown in Figure 3.1.-3. The top elevations of the vents (gaseous waste release points) in respect to the top elevation of the other buildings is shown in Figure 3.1-4.

Visual impact of the facility on the public will be very minimal to non-existent due to the proximity of highways, the low-relief terrain and the buffer zone of trees around the property.

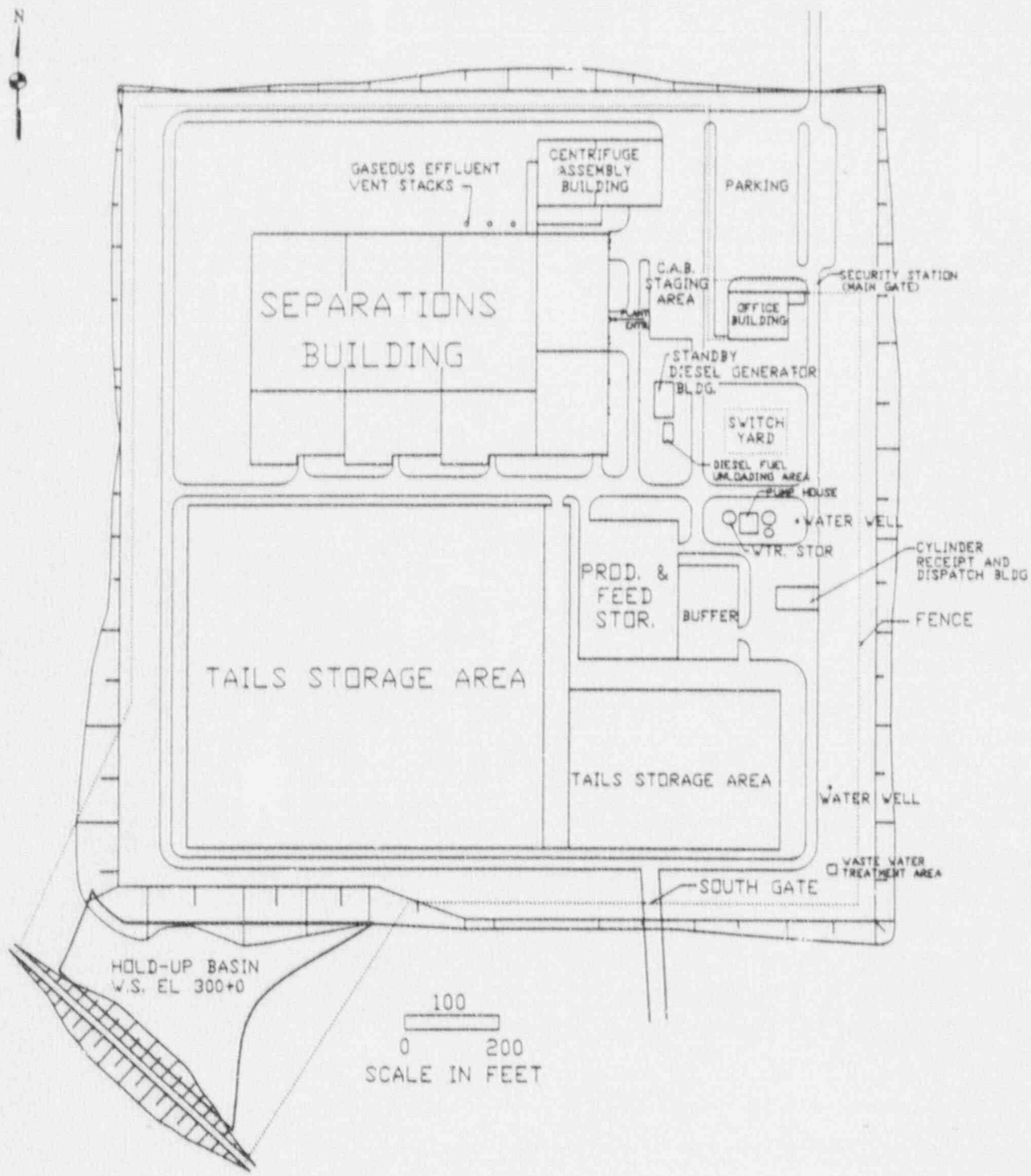


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Site Boundary-Yard El. 324+6

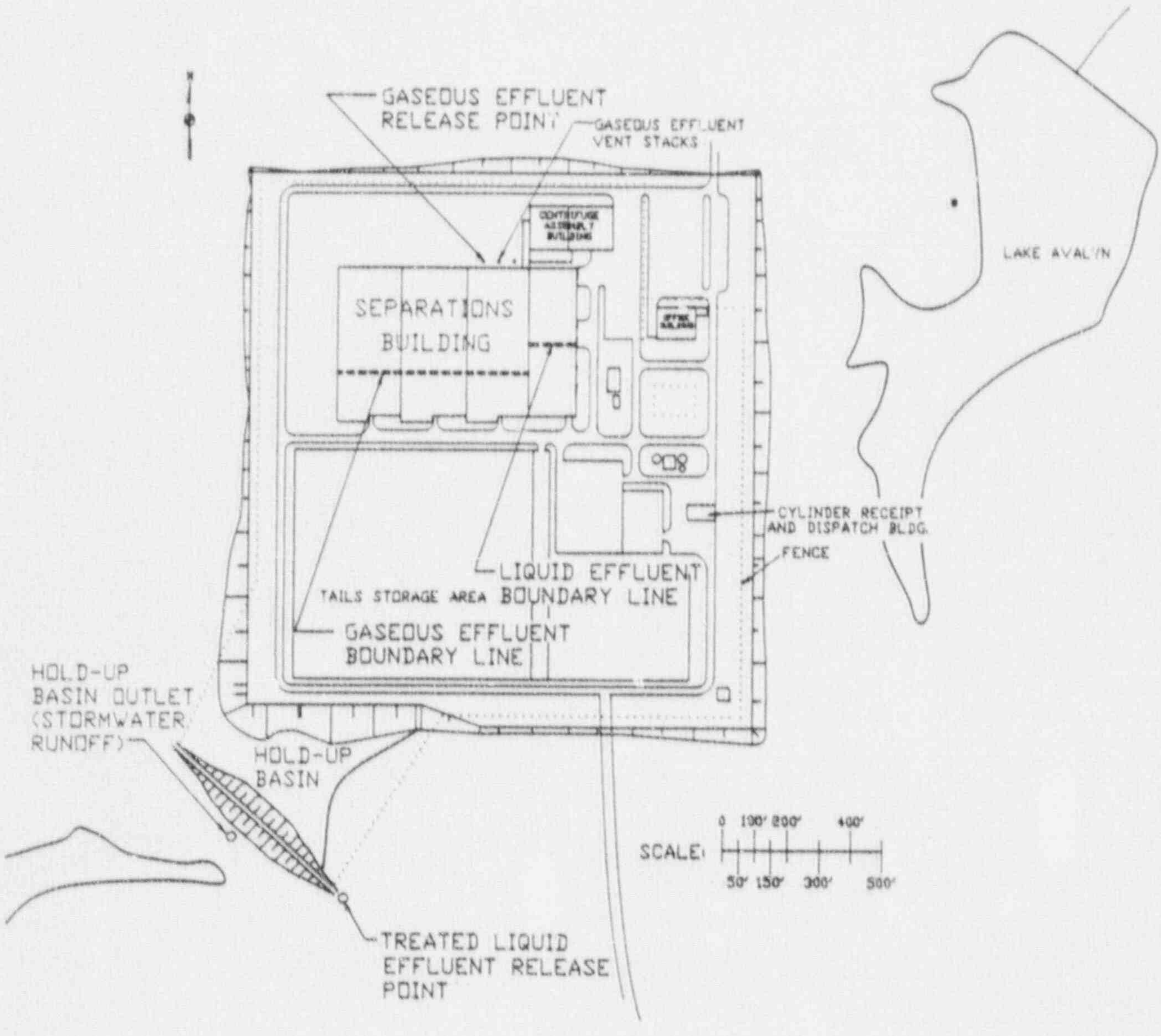
Figure 3.1-1



CLAIBORNE ENRICHMENT CENTER

Facility Buildings and Areas
Yard El. 324+6

Figure 3.1-2



LOUISIANA ENERGY

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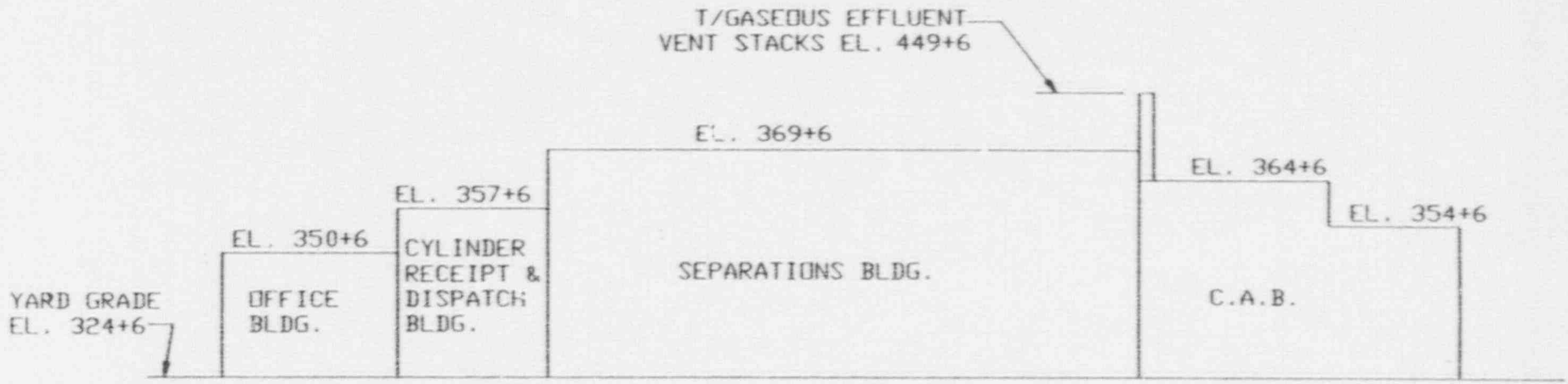
Facility Liquid and Gaseous Effluent Release Points

Figure 3.1-3



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Schematic Elevation

Figure 3.1-4

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3.2 PLANT OPERATION

During normal operation, the Louisiana Energy Services (LES) Claiborne Enrichment Center (CEC) produces non-radioactive effluents and small quantities of radioactive effluents consisting of water and other liquids, vented gases, and solids.

Figure 3.2-1, Process System Functional Block Diagram, presents an overview of plant operations. A detailed analysis of the operations and the associated activities of maintenance, repair and cleaning has identified potential sources of contamination of the normal liquid, gas and solid effluents.

Incoming UF6 arrives at the CEC in 48 inch diameter transportation cylinders, which are first checked and weighed at the Cylinder Receipt and Dispatch Building. The cylinders are unloaded by crane, inspected for integrity, weighed, and temporarily stored in the Product and Feed Storage Area.

As needed, the feed cylinders are moved into the Separations Building, and loaded into autoclaves. After purification of the UF6 to remove HF and air, the cylinders are heated to vaporize the solid UF6 into a gas. The UF6 gas flows to the centrifuges where the percentage of U-235 is increased in one flow stream (product) and reduced in the other flow stream (tails). The stream containing the increased percentage of U-235 flows to the product take-off stations, where UF6 is solidified in air cooled product cylinders. The stream containing the reduced percentage of U-235 flows to the tails take-off stations, where it is solidified in water cooled tails cylinders.

After filling and sampling, the product cylinders are moved to the Product and Feed Storage Area; the tails cylinders are moved to the Tails Storage Area. A Product Blending System is provided in the event it is necessary to blend product to customer specifications. Product cylinders are shipped to fuel fabrication facilities. The tails cylinders are stored on site.

All of the UF6 process equipment which is outside the autoclaves is operated with UF6 below atmospheric pressure. If a leak in the piping occurs, the immediate effect is an inleakage of air, not an escape of UF6. Systems designed to protect the centrifuges automatically isolate the process.

In the following sections, uranium enrichment operations are described to identify sources of radioactive and non-radioactive wastes and effluents. Flow diagrams are presented which show major process equipment, material balances and effluent streams. Flowrates for the design capacity of the plant are shown. The individual radionuclides found in plant effluents are identified. The enrichment operations do not require changing the UF6 chemically and therefore no chemical reactants or intermediate products are present. The only other uranium compounds and substances in the process arise from impurities in the UF6 or leakage into the system.

3.2.1 FEED SYSTEM

The main functions of the feed system are to purify the as received UF6, and to provide a continuous source of UF6 feed material to the centrifuges.

UF6 can exist in the liquid, solid, or vapor state, depending on its temperature and pressure. At ambient pressure, UF6 is a colorless crystalline solid that changes directly into a vapor when heated (sublimation). This type of phase behavior facilitates safe storage and handling of UF6 and is exploited throughout the operation of the enrichment process.

3.2.1.1 Purification

The most common gaseous impurities in UF6 feed are air and hydrogen fluoride (HF) from the reaction of UF6 with moisture in the air. Since these light gas impurities have a higher vapor pressure than UF6, their presence can be detected by measuring the pressure of a feed cylinder at ambient temperature.

The first step in the UF6 enrichment process is "cold" purification. A feed cylinder at ambient temperature is connected by flexible pipe to the UF6 process piping within the autoclave. Impurities such as hydrogen fluoride, air and any other light gases are extracted by venting the feed cylinder through a desublimer and chemical adsorbers.

The desublimer is designed to collect any UF6 by removing the latent heat of sublimation while allowing the light gases to flow to chemical adsorbers where remaining hazardous gases are removed. The remaining gases vent through a Gaseous Effluent Vent System. The Gaseous Effluent Vent System is described in Section 3.3, Waste Confinement and Effluent Control.

Any UF6 in the stream is collected by the desublimer, which is cooled by Freon supplied by a Cold Refrigerant System. Feed purity is assessed by reference to the incremental pressure rise in the desublimer after each purification transfer operation.

The cold purification process is repeated until the desired purity is achieved. When the desublimer reaches its UF6 operational fill limit, it is heated by Freon supplied by a Hot Refrigerant System to sublime the trapped UF6 for gaseous transfer and collection in a feed purification cylinder.

The gaseous UF6 recovered in the purification cylinder is desublimed by spraying cooled water at 39 F directly onto the cylinder. Cooling water is supplied by a Spray Cooling Water System.

The next step in the UF6 enrichment process is "hot" purification. The autoclave is first hydraulically closed and locked. Then the feed material within the cylinder is liquefied by drawing air over electrically heated coils and through a channel surrounding the feed cylinder. The temperature of the air is controlled to maintain specific cylinder pressure as the UF6 liquefies. The cylinder is vented to the desublimer when the UF6 is in the liquid phase. When the desired purity is achieved, the cylinder is placed in standby mode by closing the valve in the vent line. A temperature control system maintains the required UF6 pressure and compensates for heat loss to the environment.

When needed, the feed cylinder is connected to the feed supply header and heated to vaporize the UF6 at the required feed rate.

3.2.1.2 UF6 Feeding

The UF6 Feed System is designed to provide a continuous, controlled flow of UF6 from the feed cylinders to the centrifuges. The feed system consists of feed autoclaves, associated valves, instrumentation, and piping. The UF6 is turned into a gas (sublimed) by heating the outside of the cylinder with hot air. The gaseous UF6 is reduced in pressure to below atmospheric inside the feed autoclave and flows to the feed piping header then distributed to the centrifuges.

This system is illustrated in Figure 3.2-2, Process Flow Diagram UF6 Feed System. Major process equipment and a material balance, which includes UF6, HF, and air temperatures, pressures, and flowrates are itemized on this figure.

As the quantity of UF6 in an on-line feed cylinder decreases, the heat transfer to the UF6 feed also decreases. The air temperature setpoint increases to offset the decrease in heat transfer. The pressure within the cylinder is controlled in this manner until the air temperature can no longer maintain the required feed pressure.

At the minimum value of UF6 pressure required for continuous feed, the control mode of the autoclave flow control valve changes to maintain the upstream pressure while providing essentially unrestricted flow to the feed header. Simultaneous with this change, a standby cylinder supplements the decreasing flow from the on-line cylinder, thereby maintaining a continuous feed flow to the centrifuges.

The pressure control valve inside the autoclave reduces the UF6 vapor to a sub-atmospheric pressure of approximately 0.7 psia. With the exception of the cylinder and piping within the autoclave, all UF6 processes operate at sub-atmospheric pressures. After the contents of a feed cylinder have been reduced to a minimum, the cylinder is isolated from the feed header; then vented to the feed purification desublimer until it is empty.

The autoclave is then isolated from the purification header and allowed to cool. Meanwhile, the former standby cylinder continues to supply the full feed flow to the centrifuges.

Gaseous effluents result from UF6 purification operations and from removal of small quantities of air which enter the piping during feed cylinder connection and removal. After connecting or disconnecting cylinders the air is removed from the piping via a mobile pump set. All of these gaseous effluents are treated to remove UF6 and HF then discharged to the Gaseous Effluent Vent System for further treatment. The Gaseous Effluent Vent System is described in Section 3.3, Waste Confinement and Control.

Solid wastes are generated during the routine maintenance and change out of chemical traps and oil traps.

Liquid effluents are produced from the treatment of vacuum pump oil.

Effluent and waste quantities, treatment, and disposal are described in Section 3.3, Waste Confinement and Effluent Control.

3.2.2 ENRICHMENT SYSTEM

Purified UF6 feed enters the feed supply header with an isotopic composition (assay) of 0.711 wt% U-235. The Enrichment System yields product streams with assays ranging up to 5.0 wt% U-235 and tails streams with assays ranging from 0.20 to 0.34 wt% U-235. The isotopes are physically separated by centrifugal force in arrangements of gas centrifuges called cascades. There are seven cascades operating in parallel per assay unit and two assay units per plant unit.

The cascade feed, product, and tails flow rates are controlled to vary product and tails assays within the ranges provided above. The gas centrifuges are driven by medium frequency electric motors and are cooled by a Machine Cooling Water System.

The product streams are withdrawn from the cascades by the Product Take-Off System. Simultaneously, the tails streams are withdrawn from the cascades by the Tails Take-Off System.

Gaseous effluents result from UF6 sampling which is accomplished utilizing mobile vacuum pump sets. These gases are treated to remove UF6 and HF then discharged to the Gaseous Effluent Vent System described in Section 3.3.

Solid wastes are produced from periodic maintenance and change out of chemical and oil traps.

Liquid effluents are produced from treatment of vacuum pump oil.

Effluent and waste quantities, treatment and disposal are described in Section 3.3, Waste Confinement and Effluent Control.

3.2.3 PRODUCT TAKE-OFF SYSTEM

The Product Take-Off System continuously removes enriched gaseous UF6 product from the cascades into 30B product cylinders in the UF6 Handling Area.

The Product Take-Off System consists of first stage UF6 vacuum pumps, second stage UF6 vacuum pumps, cylinder stations, a vent system, and associated valves, valve hot boxes, and instrumentation. The vent system comprises product vent desublimers, chemical traps, vacuum pumps, and oil traps.

This system is illustrated in Figure 3.2-3, Process Flow Diagram Product Take-Off System. Major process equipment and a material balance, which includes UF6, HF, and air temperatures, pressures, and flowrates are itemized on this figure.

The enriched UF6 is withdrawn from the cascades to product cylinder stations, where it desublimes (solidifies) in air cooled cylinders. The withdrawal and transfer is effected by two vacuum pumps in series that boost the UF6 pressure to approximately 0.6 psia. An additional stage of compression is provided by a second stage UF6 vacuum pump located near the product cylinder stations. The UF6 pressure is compressed to approximately 6 psia before it is air cooled and desublimed in a 30B cylinder. The piping between the second stage pressure pump and the cylinder stations is heat traced to prevent blockage due to UF6 desublimation. Valves are enclosed in hot boxes.

Cool air is supplied to the product cylinder stations by an air cooling product cylinders subsystem of the Spray Cooling Water System.

A product vent system is used to remove uncondensed light gases (HF and air) resulting from minor inleakage to the process. These gases periodically build up in the on-line product cylinders and require removal. The vented gases pass through a desublimer designed to collect any UF6. The light gases flow through to chemical adsorbers where remaining hazardous materials are removed, then to the Gaseous Effluent Vent system for further removal of UF6 and HF prior to being discharged to the atmosphere. Small quantities of air which enter the piping during cylinder connection are removed via a mobile vacuum pump set. The mobile vacuum pump set exhausts to the Gaseous Effluent Vent System. The Gaseous Effluent Vent System is described in Section 3.3.

Solid wastes are produced during the periodic maintenance and change out of chemical and oil traps.

Liquid effluents are produced from the treatment of vacuum pump oil.

Effluent and waste quantities, treatment and disposal are described in Section 3.3, Waste Confinement and Effluent Control.

3.2.4 PRODUCT LIQUID SAMPLING SYSTEM

The function of the Product Liquid Sampling System is to take homogenized liquid samples from each product cylinder so the contents of these cylinders can be analyzed to provide the customers with verification of the product quality. The Product Liquid Sampling System consists of the product liquid sampling autoclaves and the sample bottles.

This system is illustrated in Figure 3.2-4, Process Flow Diagram, Product Liquid Sampling System. Major process equipment and a material balance, which includes UF6, HF, and air temperatures, pressures, and flowrates are itemized on this figure.

A product cylinder is loaded into a product liquid sampling autoclave from a mobile cylinder transporter. The cylinder is heated by circulating electrically heated air until the contents are liquefied and homogenized by convection. The autoclave is tilted to fill the sample bottles previously attached to the cylinder. After sampling the autoclave is cooled by circulating cooling water through an external jacket to solidify the UF6 in the cylinder and the sample bottles.

Under normal operating conditions, minor quantities of intermittent gaseous effluents result from small quantities of air which enter the piping during connecting and removing product cylinders and sample bottles. The air is removed via a mobile vacuum pump set which vents to the Gaseous Effluent Vent System described in Section 3.3.

Solid effluents are produced from change out of chemical and oil traps.

Liquid effluents are produced from the treatment of vacuum pump oil.

Effluent and waste quantities, treatment and disposal are described in Section 3.3, Waste Confinement and Effluent Control.

3.2.5 PRODUCT BLENDING SYSTEM

The function of the Product Blending System is to provide the means by which the contents of two product cylinders can be mixed to give a final product of the desired U-235 concentration.

This system is illustrated in Figure 3.2-5, Process Flow Diagram Product Blending System. Major process equipment and a material balance, which includes UF6, HF, and air temperatures, pressures, and flowrates are itemized on this figure.

The Product Blending System consists of the blending autoclaves, blended product receiver cylinder stations, blending vent desublimer subsystem, and the associated valves, valve hot boxes, piping, and instrumentation.

UF6 in product cylinders is first vented to remove light gas impurities. Then two cylinders are heated in "donor" autoclaves and transferred via pressure control to a cylinder in an air cooled product receiver cylinder station. The receiver cylinder receives UF6 from only one donor cylinder at a time. The integrated flow from the individual cylinders is controlled to achieve the desired final product U-235 concentration.

Under normal conditions, minor quantities of intermittent gaseous effluents result from UF6 cylinder venting operations and from purging and evacuation of piping during connection and removal of product cylinders. Vented gases are treated in the blending vent system, which consists of a desublimer to remove UF6 and chemical traps to remove remaining hazardous gases. The gases are then discharged to the Gaseous Effluent Vent System for further treatment. The small quantities of air which enter the piping during cylinder connection are removed via a mobile vacuum pump set. The mobile vacuum pump set exhausts to the Gaseous Effluent Vent System described in Section 3.3.

Solid effluents are produced from change out of the chemical and oil traps.

Liquid effluents are produced from the treatment of vacuum pump oil.

Effluent and waste quantities, treatment and disposal are described in Section 3.3, Waste Confinement and Effluent Control.

3.2.6 PRODUCT STORAGE AND SHIPPING SYSTEM

The Product Storage and Shipping System serves as a storage area for the sampled and blended product cylinders. The Product Storage and Shipping System consists of the storage area, reinforced chocks for holding cylinders, mobile cylinder transporters, and a shipping dock in the Cylinder Receipt and Dispatch Building. A scale and crane are located in this building. The product cylinders are stored resting on chocks in the outdoor storage area. A cylinder is retrieved from storage with a mobile cylinder transporter, and conveyed to the shipping dock where it is weighed. With the use of an overhead crane, the cylinder is then loaded onto a truck for shipping.

No effluents of any kind - solid, liquid, or gas, arise from this area.

3.2.7 TAILS TAKE-OFF SYSTEM

The Tails Take-Off System continuously withdraws depleted UF6 from the enrichment cascade into tails cylinders. The depleted UF6 is drawn from the cascades by vacuum pumps and transferred through piping headers to tails stations where it is desublimed in water spray cooled cylinders. The Tails Take-Off System consists of UF6 vacuum pumps, cylinder stations, and the associated valves, valve hot boxes, piping, and instrumentation.

This system is illustrated in Figure 3.2-6, Process Flow Diagram Tails Take-Off System. Major process equipment and a material balance, which includes UF6, HF, and air temperatures, pressures, and flowrates are itemized on this figure.

Light gas impurities preferentially collect in the product cylinders. However, albeit rarely, ventilation of light gases collected in the tails cylinders might be required. Minor quantities of gaseous effluents are produced from the purging and evacuation of piping during connection and removal of the tails cylinders.

Vented light gases, if any, are routed back to the feed purification subsystem for removal of UF6 and HF. The small quantities of air which enters the piping during cylinder connection are removed via a mobile vacuum pump set. The mobile vacuum pump set exhausts to the Gaseous Effluent Vent System described in Section 3.3.

Solid effluents are produced from change-out of chemical and oil traps.

Liquid wastes may be produced from the treatment of vacuum pump oil. Under normal conditions, there are no liquid effluents from the closed-circuit spray cooling water.

Effluents and waste quantities, treatment and disposal are described in Section 3.3, Waste Confinement and Effluent Control.

3.2.8 TAILS STORAGE SYSTEM

The Tails Storage System consists of an outdoor storage area, reinforced chocks on which the cylinders rest, and a mobile cylinder transporter. Cylinders are transferred by the mobile transporter from the UF6 Handling Area of the Separations Building to the tails storage area where they rest on chocks for storage.

No effluents of any kind - solid, liquid, or gas, are anticipated from this area.

3.2.9 AUXILIARY SERVICES

Utility services such as electric power, gaseous and liquid nitrogen, compressed air, Freon (used as hot and cold heat transfer media) and cooling water are supplied to support the primary process facilities. Steam is not required. Ancillary activities such as maintenance, repair, decontamination, laboratory analysis and centrifuge assembly are also performed in conjunction with the process facilities. These functions require separate work areas and facilities.

The function of the Utilities System is to reliably supply the vital services required for the operation of the UF6 Process System and other services required for the operation of the balance of the plant. Services that support process operations include gaseous nitrogen for purging and blanketing, compressed air for instruments and controls, hot and cold Freon for desublimer temperature control, cooling water for the rejection of heat loads, and standby power generation.

3.2.9.1 Well Water System

A Well Water System, designed with redundancy, supplies the utility and potable water system and the fire protection system. Water is treated by a water softener and charcoal filters.

Utility and potable water are distributed from the same treated water storage tank, but are segregated with backflow preventers to protect the potable water from potential contamination from the utility water system.

Fire Protection water comes from the same treated well water, and is used to fill and provide make-up water to two 100% capacity fire protection tanks. The volume of each storage tank is sufficient to fight the worst-case design basis fire for two hours with a 500 gallon per minute hydrant flow rate.

Water quantity, consumption, and discharge are illustrated in Figures 3.2-7, Process Flow Diagram Utility/Potable Water System, and 3.2-8, Flow Diagram Utility Water System. Temperatures, pressures, and flowrates are quantified by stream number on Figure 3.2-7.

3.2.9.2 Potable Water

Potable water is required for drinking, washing, toilets, showers, eyewash and safety shower stations, laboratories, and workshops.

Potable water is supplied to the Potable Water System from the Utility Water System, then distributed to its users as follows:

a. Separations Building
   - Health Physics & Chemical Labs
   - Locker Rooms
   - Lunch room and drinking fountains
   - Restrooms, and service sinks
   - Emergency showers & eye wash
   - Environmental Laboratory
   - Laundry
   - Personnel Decontamination Room

b. Centrifuge Assembly Building
   - Restrooms and service sinks
   - Lunch room and drinking fountains
   - Emergency showers & eye wash

c. Cylinder Receipt and Dispatch Building
- Restrooms
- Service sinks
- Drinking fountains

d. Office Building
- Restrooms and service sinks
- Lunch room and drinking fountains

Potable water that is not consumed, except most laboratory and workshop drains, drains to the Sewage Treatment System. The Environmental Laboratory also drains to the Sewage Treatment System. The chemical and health physics laboratories, laundry effluent, and workshop drain to the Liquid Waste Disposal System. The Sewage Treatment System and the Liquid Waste Disposal System are described in Section 3.3, Waste Confinement and Effluent Control.

3.2.9.3 <u>Utility Water</u>

Utility Water is used for the balance of plant needs, other than those requiring demineralized water. Systems using utility water for filling and makeup include: the Main Plant Cooling Water System, the Spray Cooling Water System, and the Hot Water System.

3.2.9.3.1 Main Plant Cooling Water

All excess heat generated by the CEC processes and HVAC systems is rejected to the atmosphere by the Main Plant Cooling Water (MPCW) System in each plant unit.

The MPCW System consists of three closed loop cooling water systems. Each closed loop MPCW consists of three air-cooled chillers, two water circulation pumps, an expansion vessel, distribution piping, and instrumentation.

The system is illustrated in Figure 3.2-9, Process Flow Diagram Main Plant Cooling Water System. Major equipment and temperatures, pressures, and flowrates are quantified by stream number on this figure.

The MPCW System in Plant Unit 1 provides 45 F cooling water to:

a. Machine (i.e. centrifuge) Cooling Water System

b. Heating, Ventilation, and Air Conditioning (HVAC) Systems

c. Spray Cooling Water System

d. Cold Freon System

e. Product Blending System

f. Product Sampling System

g. Plant and Instrument Air System

h. Technical Services Area

i. Standby Generator Building

Air-cooled chillers service the MPCW using Freon R-22 refrigerant. A manually operated chemical addition system is provided for periodic addition of biocide and corrosion inhibitor. An expansion tank in the cooling water return line is provided to accommodate liquid expansion in the system. System equipment and distribution piping are insulated to limit heat gains and prevent condensation on the piping surface.

Since the MPCW is a closed loop system, no release of effluents - solid, liquid, or gas - is anticipated.

3.2.9.3.2 Spray Cooling Water System

A separate closed loop Spray Cooling Water System is provided for each plant unit. The Spray Cooling Water System supplies cooling water for desubliming UF_6. Cooling water is sprayed directly on UF_6 cylinders in the ten tails cylinder stations and the feed purification cubicle. Cooling water is also supplied to air coolers that circulate air required to desublime UF_6 in the ten product cylinders and in the five product blending cylinders.

This system is illustrated in Figure 3.2-10, Process Flow Diagram Spray Cooling Water System. Major process equipment and temperatures, pressures, and flowrates are quantified by stream number on the figure.

In the tails cylinder stations and feed purification cubicle, the cylinder is sprayed with a total of 12 gpm of cooling water through 12 spray nozzles distributed over two spray headers. The spray water from the ten tails cylinder stations and one feed purification cubicle collects on the floor in the enclosures and flows by gravity to the spray water storage tank.

Since the Spray Cooling Water System is a closed loop system, no release of effluents, solid, liquid or gas, arises.

3.2.9.3.3 Hot Water System

The Hot Water System is located in the Utility Area of the Separation Building, and services all three plant units. This closed loop system provides heating service to the Hot Refrigerant System and to the Heating, Ventilation, and Air Conditioning (HVAC) Systems. Because building heat is not required continuously, separate heating subsystems are provided to supply hot water to the hot refrigerant heaters and the HVAC air handling units. Each subsystem comprises a hot water expansion vessel, hot water circulation pumps, a chemical addition system, an electric water heater, and associated distribution piping, instrumentation, and controls. This system is illustrated in Figure 3.2-11, Process Flow Diagram Hot Water System. Major process equipment and temperatures, pressures, and flowrates are quantified by stream number on this figure.

Drains are provided for the collection of any hot water that leaks from the system. This water is collected by the Liquid Effluent Discharge System; sampled, tested, and treated if necessary before discharge to the plant sanitary sewer. The Liquid Effluent Discharge System is described in Section 3.3, Waste Confinement and Effluent Control.

3.2.9.3.4 Machine Cooling Water System

A Machine Cooling Water System (MCWS) is provided in each plant unit. The function of the MCWS is to supply cooling service to the cooling coils of the centrifuges. This system provides stringent control over the operating temperature of the centrifuges to enable their efficient operation.

Each MCWS serves 14 centrifuge cascades. The MCWS consists of a closed loop water system utilizing circulating pumps, an expansion vessel, a water cooler, a cartridge-type water polishing unit and associated piping and instrumentation. The machine cooling water is cooled with main plant cooling water. The MCWS circulates a total of 1050 gpm of demineralized cooling water to the fourteen cascades of each plant unit at a supply temperature of 78.8 F. Individual cascade circulation pumps circulate 250 gpm of cooling water at a temperature of 86 to 89.6 F through each cascade to maintain precise control of the centrifuge casing temperature. This system is shown in Figure 3.2-12, Flow Diagram - Machine Cooling Water. Major equipment, temperatures, pressures and flowrates are shown on the figure. Since this is a closed loop system no release of effluents arises.

3.2.9.3.5 Demineralized Water Storage

A single Demineralized Water Storage System is provided for the three plant units. The function of the system is to furnish demineralized water storage capacity and system filling and makeup capability to the three machine cooling water expansion tanks.

Stored demineralized water and the tank storage supply pump are used to fill the three machine cooling water systems and to provide makeup water to the respective MCW expansion tanks as required. This system is functionally depicted in Figure 3.2-13, Process Flow Diagram, Demineralized Water Storage. Major equipment, temperatures, pressures and flow rates are shown on the figure. The system supplies a closed loop system and no effluent release is anticipated.

3.2.9.4 Technical Services Area

The Technical Services Area houses many of the auxiliary activities. The first floor level houses the following functional areas:

a. Electrical distribution area

b. Electrical workshop

c. Mechanical workshop

d. Miscellaneous storage

e. Environmental laboratory

f. Chemical storage

g. Hazardous waste storage

h. Locker rooms

i. Restrooms

j. Personnel decontamination area

k. Chemical laboratory

l. Health physics laboratory

m. Sample storage area

n. UF6 sample room

o. ICP spectrometer room

p. Counting room

q. UF6 equipment workshop

r. Decontamination workshop

s. Contaminated equipment workshop

t. Pump disassembly rooms

u. Contaminated workroom

v. Contaminated laundry

w. Liquid waste tank room

x. TSA effluent pit

y. Radioactive waste storage

z. Truck bay

The second floor level houses the following functional areas:

a. Central control room

b. HVAC equipment room

c. Lunch room

d. Conference room

e. Office space, restrooms and corridors.

Hoods in the Technical Services area vent via booster fans to the Gaseous Effluent Vent System for treatment to remove hazardous chemicals. Areas and rooms are exhausted to the HVAC system.

Solid and liquid wastes are generated during decontamination operations, chemical analysis and maintenance activities. The quantities of wastes, their treatment and disposal are described in Section 3.3.

3.2.9.5 Nitrogen System

The function of the Nitrogen System is to supply the plant liquid and gaseous nitrogen. A single system serves the Separations Building and the Standby Generator Building.

The Nitrogen System is shown in Figure 3.2.14, Process Flow Diagram, Nitrogen System. Major equipment and temperatures, pressures and flowrates are shown on the figure. It consists of a liquid nitrogen bulk storage vessel, vaporizer, gaseous nitrogen heater, liquid and gaseous nitrogen distribution lines and instrumentation. Liquid nitrogen is delivered by tanker and stored in the storage vessel. Liquid nitrogen required for the mass spectrometers and cold traps is delivered to the point of use in portable Dewars filled at a liquid nitrogen dispensing station. Gaseous nitrogen required for blanketing, purging and drying is distributed at 30 psig to the points of use by a piping network.

Gaseous nitrogen is used in the process systems for the following applications:

a. For purging and filling any UF6 piping which has been exposed to the atmosphere during connection and disconnection of UF6 cylinders. As described earlier, this nitrogen is vented to the Gaseous Effluent Vent System.

b. For filling the insulation area of the desublimers to avoid moisture which could condense and freeze when switching from the hot to cold desublimer operating mode. This nitrogen vents to the HVAC System.

After treatment, nitrogen effluents are vented to the atmosphere. There are no liquid or solid effluents produced by this system.

3.2.9.6 Plant and Instrument Air

The function of the Plant and Instrument Air System is to supply a reliable source of instrument air to pneumatically controlled instruments and to meet plant utility air requirements.

The Plant and Instrument Air System is shown in Figure 3.2-15, Process Flow Diagram, Plant/Instrument Air System. Major equipment and temperatures, pressures and flowrates are shown on the figure. The system consists of two 100% capacity commercially packaged compressed air units, duplex filter/driers, and two instrument air receivers. The system is controlled to ensure preferential instrument air service. Ring headers are used in each plant unit to increase system reliability. Air is distributed to the points of use through carbon steel and copper piping.

Clean, dry and oil-free air is supplied to the process systems to operate instruments and valves. For safety, the main power supply serving the air system is backed-up by standby diesel generators. Critical air lines are supplied with one-way valves. Critical components served by the air system are designed to be fail-safe. In addition, duplicate air receiver vessels provide a total of 20 minutes of air supply to allow the plant to be put in a safe state in case of a complete power failure.

Effluents from the system include clean air vented to the atmosphere and small quantities of condensate.

3.2.9.7 Freon Supply System

The functions of the Freon System are to meet the cooling and heating requirements of the UF_6 desublimers in the process systems. This system consists of a Refrigerant (Freon) Supply System and a Hot and Cold Refrigerant (Freon) Circulating System. Freon R11 is selected as the heat transfer medium because it:

a. Displays good heat transfer, viscosity and vapor pressure in the temperature ranges required

b. Does not contain hydrogen, a moderator

c. Has relatively low toxicity; however, due to the potential of adverse environmental effects, provisions are incorporated to recover nearly all Freon vapor.

The systems are shown in Figures 3.2-16, Flow Diagram, Refrigerant Supply System, 3.2.17, Process Flow Diagram, Cold Refrigerant System, and 3.2-18, Process Flow Diagram, Hot Refrigerant Supply System.

The refrigerant supply system provides storage volume for receipt of new freon, and it supplies clean, dry makeup Freon to the Hot and Cold Freon Systems. The system is provided with a recovery system to condense, subcool and collect Freon vapor.

The Cold Freon System supplies freon to the desublimers' cooling coils. Separate coils are used for heating. The temperatures maintained by the circulating cold Freon cause UF6 to desublime and collect as a solid in the desublimers.

The Hot Freon System supplies freon to the desublimers heating coils. The temperatures maintained by the circulating hot Freon cause the solid UF6 in the desublimers to sublime so that it can be conveyed in the gaseous state for collection in cooled cylinders.

The closed-loop Freon systems are designed to recover Freon and its vapors and there are no effluents from the system.

3.2.9.8 Electricity

The peak operating load for the LES uranium enrichment facility, when at full capacity is approximately 22 MVA. The design capacity is approximately 26 MVA. Energy consumption will be on the order of 17 million kWH. Electricity is supplied by two 115 kV overhead distribution lines coming from two different substations from the Louisiana Power and Light Utility (LP & L) grid system.

3.2.10 DECONTAMINATION

The Decontamination System is designed to remove radioactive contamination from equipment used to handle uranium hexafluoride and miscellaneous equipment used in other radioactive services. The principal forms of radioactive contamination found in the plant are uranium tetrafluoride (UF4), and uranyl fluoride (UO2F2).

Equipment and process components normally decontaminated by this system include: UF6 vacuum pumps, valves, sections of piping, and UF6 sample bottles. Other miscellaneous equipment normally not associated with UF6 handling or processing that are decontaminated by this system, include: pumps, valves, and instruments from radioactive effluent systems; tools; and scrap metals.

3.2.10.1 Processes for Decontamination

Equipment to be decontaminated is disassembled in a dedicated, Contaminated Equipment Workshop. Ventilated rooms to contain UF6 vapors and its breakdown products are provided for this procedure. If grease and oil present in and on the components inhibits decontamination, these components are first processed in a solvent vapor degreasing unit.

The decontamination processes in CEC consist of:

a. Citric Acid bath with air spray agitation and a heater for the removal of UF4 and UO2F2.

b. Wet blasting with high pressure water and glass beads fo. removal of adhering contamination.

All components are dried after decontamination in dedicated drying cabinets.

3.2.10.2 Effluents from Decontamination

Exhausts from the dedicated, ventilated rooms, and wet blasting cabinets are vented to the Gaseous Effluent Ventilation System.

Liquids, including solvents and oils, are collected and transferred to the Liquid Waste Disposal System. Liquids from the decontamination process also include rinse water which is collected in the decontamination effluent monitor tank and citric acid solution which is collected in the citric acid collection tanks.

Fomblin oil, a highly fluorinated, inert oil, is used exclusively in vacuum pumps to avoid reaction with UF6. Fomblin oil contained in vacuum pumps is drained into collection containers in the ventilated booths and transferred to a Fomblin Oil Recovery System.

Metallic wastes and other unusable components that have been thoroughly decontaminated are transferred to the Solid Waste Disposal System for disposal as industrial waste.

The quantities, treatment and disposal of these wastes is described in Section 3.3, Waste Confinement and Effluent Control.

3.2.11 CONTAMINATED LAUNDRY SYSTEMS

The Contaminated Laundry System is designed to clean dirt and uranium contamination from washable clothing and from materials used in Radiation Control Zones of the CEC.

Laundry normally handled by this system consists of:

a. Clothing, including coveralls, gloves, and shoe covers, used by plant personnel while working in areas which become contaminated.

b. Pressure suits used by plant personnel in areas with potential airborne contamination.

c. Towels and rags used in the Personnel Decontamination Room.

3.2.11.1 <u>Collection Process of Contaminated Laundry</u>

Contaminated laundry is collected in specified containers as personnel exit areas of potential contamination. These containers are lined with plastic bags. When full, the bags are sealed and removed from containers in the area and taken to the contaminated laundry room where they are stored until cleaned.

3.2.11.2 <u>Cleaning Process in the Contaminated Laundry System</u>

Contaminated laundry is washed in two dedicated, industrial quality contaminated laundry washing machines, each having the capacity of 150 pounds dry weight laundry. Cleaned laundry is dried in two dedicated, industrial quality contaminated laundry dryers, each having a capacity of 150 pounds dry weight laundry. The cleaning process in this system uses hot water at a minimum of 180 F, washing detergents, and bleach. This process achieves dirt removal, odor removal, and disinfection.

3.2.11.3 <u>Effluents from the Contamination Laundry System</u>

Waste water from the contaminated laundry machines is collected in two stainless steel Laundry Effluent Monitor Tanks in the Liquid Waste Disposal System. Each tank has a dedicated transfer pump, a capacity of 2000 gallons, and is sized to collect one normal week of laundry system waste water.

Air from the Contaminated Laundry Dryers is vented to the Technical Services Area HVAC System.

Clothing and rags that are contaminated with oil or hazardous materials are collected at the point of contamination in specific containers. These are handled separately from contaminated laundry. This material is transferred to the Solid Waste Disposal System.

After drying, cleaned laundry is inspected for suitability for reuse. Any articles that are unsuitable are transferred to the Solid Waste Disposal System.

The quantities, treatment and disposal of solid, gaseous and liquid effluents from the contaminated Laundry System is described in Section 3.3, Waste Confinement and Effluent Control.

3.2.12 PLANT EFFLUENTS

During normal operations, the CEC will produce effluents such as thermal energy, processed sewage, monitored waste water and process ventilation gases. Liquid and solid wastes which potentially contain radioactive or hazardous materials are monitored and treated if required, prior to release or shipment. No liquid or solid effluents containing radioactivity are continuously produced as an integral part of the enrichment process but arise as a result of cleanup of vented gases, and due to maintenance and analytical activities. Process gases are all treated to remove hazardous materials and are vented through the Gaseous Effluent Vent System for further treatment. Essentially all hazardous materials are removed prior to release to the atmosphere. From previous experience in URENCO plants in Europe, releases of gaseous UF6 are on the order of one to two grams per year. Every effort has been made to contain and confine these effluents rather than release them directly to the environment. The effluents are detailed in the following sections dedicated to solid, liquid, and gas.

3.2.12.1 Solid Waste Disposal System

Solid wastes can be either wet or dry, depending on the source of these effluents. The treatment and quantities of solid waste is described in Section 3.3, Waste Confinement and Effluent Control.

3.2.12.1.1 Wet Solid Waste

This portion of the Solid Waste Disposal System includes the wet solid waste generated by the CEC facility such as:

a. Wet trash and wet abrasive materials

b. Oil recovery sludge

c. Demineralizer resins

d. Miscellaneous hazardous wastes

3.2.12.1.2 Dry Solid Waste

The dry solid waste generated in the CEC includes:

3.2.12.1.3 Trash

Trash consists of paper, wood, gloves, cloth, cardboard, and non-contaminated waste from all plant units. Some items require special handling, and are not included in this category, notably: paints, aerosol cans, and containers in which hazardous materials are stored or transported. Trash from radiation control areas is collected and processed separately from non-contaminated trash.

3.2.12.1.4 Activated Carbon

This waste is bulk activated carbon from chemical traps and air filters. The differential pressure across the carbon filters in continuously monitored. Carbon traps are weighed annually to monitor hold-up. Filters and traps are changed out as they near capacity. Removal and replacement of the filter and trap contents is done in a ventilated room in the Technical Services Area.

3.2.12.1.5 Activated Alumina

Activated alumina (Al2O3) as a waste is in granular form. Most is contaminated; instrument air desiccant is not. Hold-up on the alumina is checked by weighing and changed out when near capacity. Air desiccant alumina is replaced as necessary.

3.2.12.1.6 Air Filters

Air filters, as a waste, consist of fiberglass or cellulose filters. Only the Gaseous Effluent Vent System filters will be contaminated and will contain much less than 1% by weight UO2F2. HVAC filters, instrument air filters, air cooling filters from product take-off and blending systems, and standby generator air filters are not contaminated.

HF resistant HEPA filters are composed of fiberglass. HEPA filters are replaced on a differential pressure basis.

3.2.12.1.7 Silica Gel

Silica gel, as a waste, is in the form of granules and is not contaminated. The silica gel is used to dry the Freon refrigerant in refrigeration units. The gel is replaced once per year. The waste will not contain Freon. The Freon will be gassed off and recovered.

3.2.12.1.8 Sodium Fluoride

Sodium fluoride (NaF) comes in granular and powder forms. NaF adsorbs up to either 150% of its weight in UF6 or 50% of its weight in hydrogen fluoride (HF). Use of NaF is confined to Cascade Halls. NaF is not an operational waste. Contaminated NaF is collected and disposed of at the end of the plant life. Expected quantities are given in Section 3.3.

3.2.12.2 Liquid Wastes and Effluents

A Liquid Effluent Discharge System is provided in each plant unit. The system handles all normally non-contaminated liquid waste. A part of the Liquid Waste Disposal System collects, identifies, stores, and processes aqueous wastes generated in the Separations Building that are potentially contaminated with radioactive material. These aqueous wastes are released from the plant if they meet, or are processed to meet, regulatory limits for water quality.

Liquid non-aqueous effluents collected in the Liquid Waste Disposal System include: lubrication oils; solvents and refrigerants; and laboratory chemicals. Fomblin oils are not handled in this system, but in the Fomblin Oil Recovery System.

Sources of the non-aqueous wastes include miscellaneous wastes collected in small amounts from various activities performed throughout the plant. Lubrication oils arise from process equipment maintenance, plant vehicle maintenance, and workshop activities.

Solvents and refrigerants emanate from decontamination activities, workshop maintenance and centrifuge assembly, change outs and maintenance to the Hot and Cold Refrigerant Systems, Main Plant Cooling Water System, Spray Cooling Water System chillers, and air conditioning system maintenance. Laboratory chemicals include effluents and waste from the Health Physics, Chemical, and Environmental Laboratories.

The Sewage Treatment System is designed to process domestic sewage to meet effluent water quality standards set forth by the Louisiana Department of Environmental Quality and the Environmental Protection Agency.

The quantities, treatment, and disposal of these liquid effluents are described in Section 3.3.

3.2.12.3 Gaseous Wastes and Effluents

Potentially contaminated and non-contaminated gases are collected from fixed connections at vacuum pumps and autoclaves, and from mobile vacuum pump and flexible hose connections throughout the plant, and directed to the Gaseous Effluent Vent System. The Gaseous Effluent Vent System is described in Section 3.3.

3.2.13 DESIGN CAPACITY OF THE LES FACILITY

The enrichment capacity of the plant is expressed in terms of separative work units (SWU) and the availability of the plant over the year to exercise this capacity.

The SWU quantifies an enrichment effort by the level of force or energy and the amount of feed necessary to produce a certain enrichment and depletion levels. Enrichment plant capacity is a function of the quantities of material fed to and withdrawn from the process and the isotopic assay of each of these streams.

3.2.13.1 SWU Capacity, Design Stream Factor

The nominal enrichment capacity of the LES plant is 1.5 million Kg SWU per year, based on operations at an availability of 100%, or 8760 hours per year. This is the combined separative work capacity of the three plant units. Each plant unit is, in turn, comprised of two assay units for a plant total of six. Each assay unit consists of seven cascades for a plant unit total of fourteen and a plant total of forty-two.

3.2.13.2 Feed, Product, and Tails Flow and Assays

The flow rates of feed, product, and tails depend on the enrichment capacity of the assay unit at that point in time and the U-235 concentration of the product and tails.

The configuration of the centrifuges within an assay unit determines the U-235 assay of the product and tails streams which can be produced at a given feed rate, and feed concentration.

The nominal continuous flow rates are given in Table 3.2-1.

3.2.14 RADIOACTIVITY OF CEC EFFLUENTS

The radioactive feed material used in the CEC is uranium, consisting of its natural composition of isotopes, U-238, U-235, and U-234. Tables 3.2-2, 3.2-3, and 3.2-4 list uranium, its isotopes, its natural composition and chemical properties. The content of U-235 in the feed is about 0.7%. Enriched product will be in the range of up to 5% U-235, depending on customer requirements. No reprocessed fuel is used in the CEC facility. Therefore, the radionuclides shown in Table 3.2-2 and their breakdown products will be the only ones included in wastes and effluents from the LES Facility.

In 10 CFR 20, Protection Against Radiation, Section 105, federal regulations stipulate the permissible levels of radiation in effluents released to unrestricted areas.

Wastes that are potentially contaminated with radioactive materials are transferred to the Radioactive Waste Storage Area. Non-contaminated wastes are segregated in the Chemical Storage Area.

Radioactive wastes are sampled and analyzed to determine the quantity and isotopic distribution then labeled and packaged in accordance with 10 CFR Parts 61.55, 61.57 and 49 CFR Part 173. These wastes are normally shipped off site to a central volume reduction facility or to an offsite radioactive waste disposal facility for processing.

Table 3.2-1
Nominal Continuous Flow Rates

	Plant Unit 1		Plant Unit 2		Plant Unit 3	
Assay Unit	A	B	C	D	E	F
Product assay, wt%	2.0	2.5	2.5	2.5	2.5	2.5
Feed, lbs/hr	277.8	240.3	240.3	240.3	240.3	240.3
Product, lbs/hr	61.7	41.9	41.9	41.9	41.9	41.9
Tails, lbs/hr	216.1	198.4	198.4	198.4	198.4	198.4

Table 3.2-2
Radiological Characteristics of Natural UF6 Feed

Nuclide*	Atomic Ratic ppb in Natural Uranium**	Half Life	Maximum Radiation Energies (Mev) and Intensities		
			Alpha α	Beta β	Gamma γ
92U238	9.927E8	4.51E9y	4.15 25% 4.20 75%	N/A	N/A
90TH234	0.0145	24.1d	N/A	0.103 21% 0.193 79%	0.063 3.5% 0.093 4.0%
91Pa234	4.9E-7	1.17min	N/A	2.29 98%	0.765 0.3% 1.001 0.6%
92U234	5.44E4	2.47E5y	4.72 28% 4.77 72%	N/A	0.053 0.2%
92U235	7.205E6	7.1E8y	4.37 18% 4.40 57% 4.58 8%	N/A	0.143 11% 0.185 54% 0.204 5%

* Found also in solid waste and in gaseous and liquid effluents from the LES facility.

** Natural uranium products are removed in processing yellow cake to UF6 and are not found in these ratios in UF6 feed.

Table 3.2-3
Properties of UF6

Property	Value
Sublimation point (14.7 psia)	133.8 F
Triple point	22 psia, 147.3 F
Density, solid @ 68 F Liquid @ 147.3 F Liquid @ 200.0 F Liquid @ 235.0 F Liquid @ 250.0 F	317.8 lb/ft3 227.7 lb/ft3 215.6 lb/ft3 207.1 lb/ft3 203.3 lb/ft3
Heat of Sublimation @ 147 F of Fusion @ 147 F of Vaporization @ 147 F	58.2 Btu/lb 23.5 Btu/lb 35.1 Btu/lb
Specific Heat Solid @ 81 F Liquid @ 81 F	0.114 Btu/lb 0.130 Btu/lb
Critical Pressure Critical Temperature	668.8 psia 446.4 F

Table 3.2-4
Chemical Reaction Properties

Major Reactions	Heat of Reaction* (Btu/ lb-mole)	Free Energy of Reaction* (Btu/ lb-mole)
UF6 Decomposition		
$UF_6 \rightarrow U + 3F_2$	+ 928,811	+ 873,010
$UF_6 \rightarrow UF_4 + F_2$	+ 131,502	+ 113,941
UF6 Hydrolysis		
$UF_6(g) + 2H_2O(g) \rightarrow UO_2F_2(s) + 4HF(g)$	- 90,901	- 60,481
HF Reaction with Glass		
$HF + SiO_2 \rightarrow SiF_4 + 2H_2O$	- 45,810	- 36,000

* Reference point = 77 F at 14.7 psia

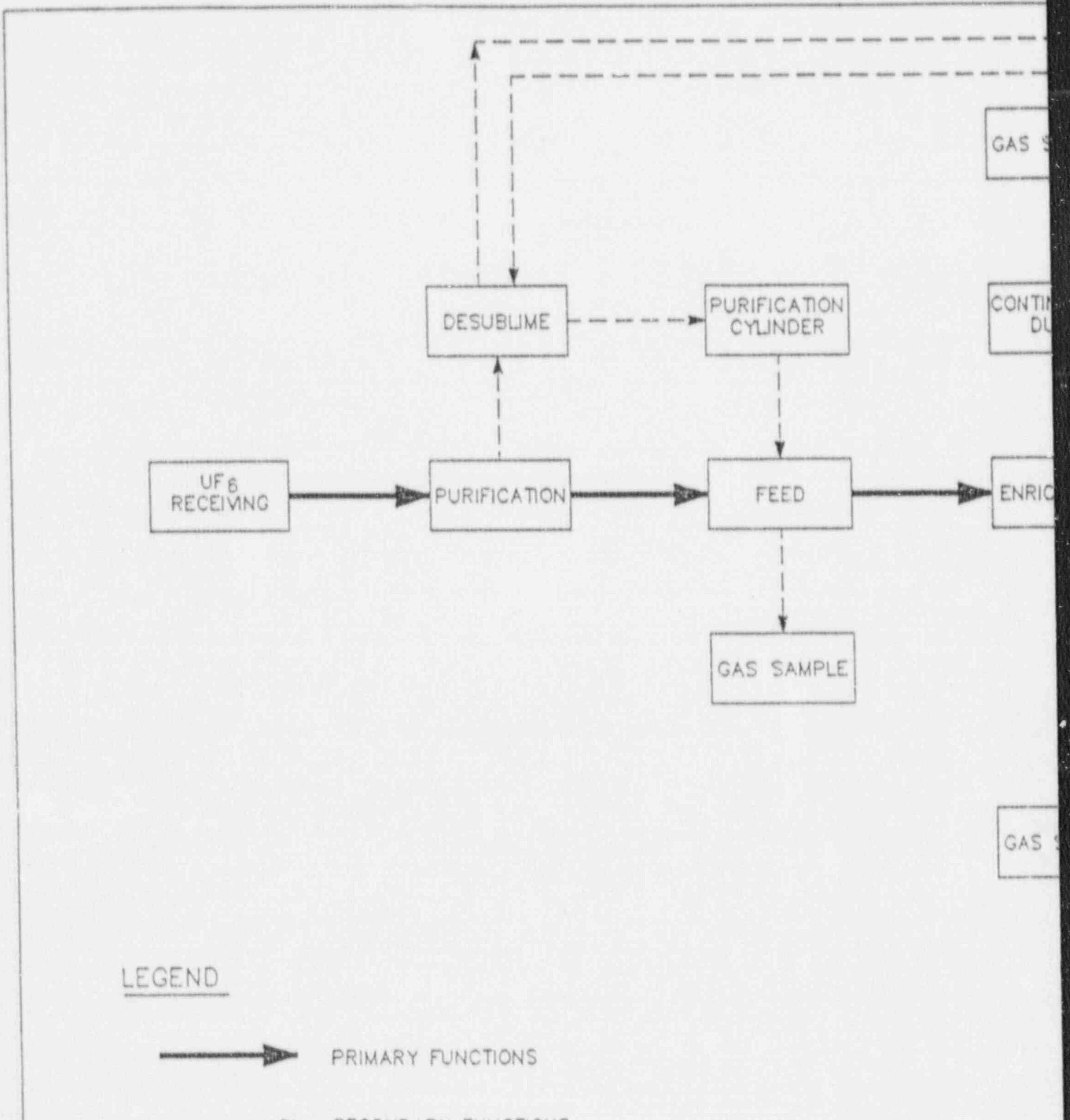
- UF_6 is completely stable with H_2, N_2, O_2 and dry air at ambient temperature.
- UF_6 reacts with most organic compounds to form HF and carbon fluorides.
- Fully fluorinated materials are quite resistant to UF_6 at moderate temperatures.
- UF_6 has metathesis reactions with oxides and hydroxides, for example:

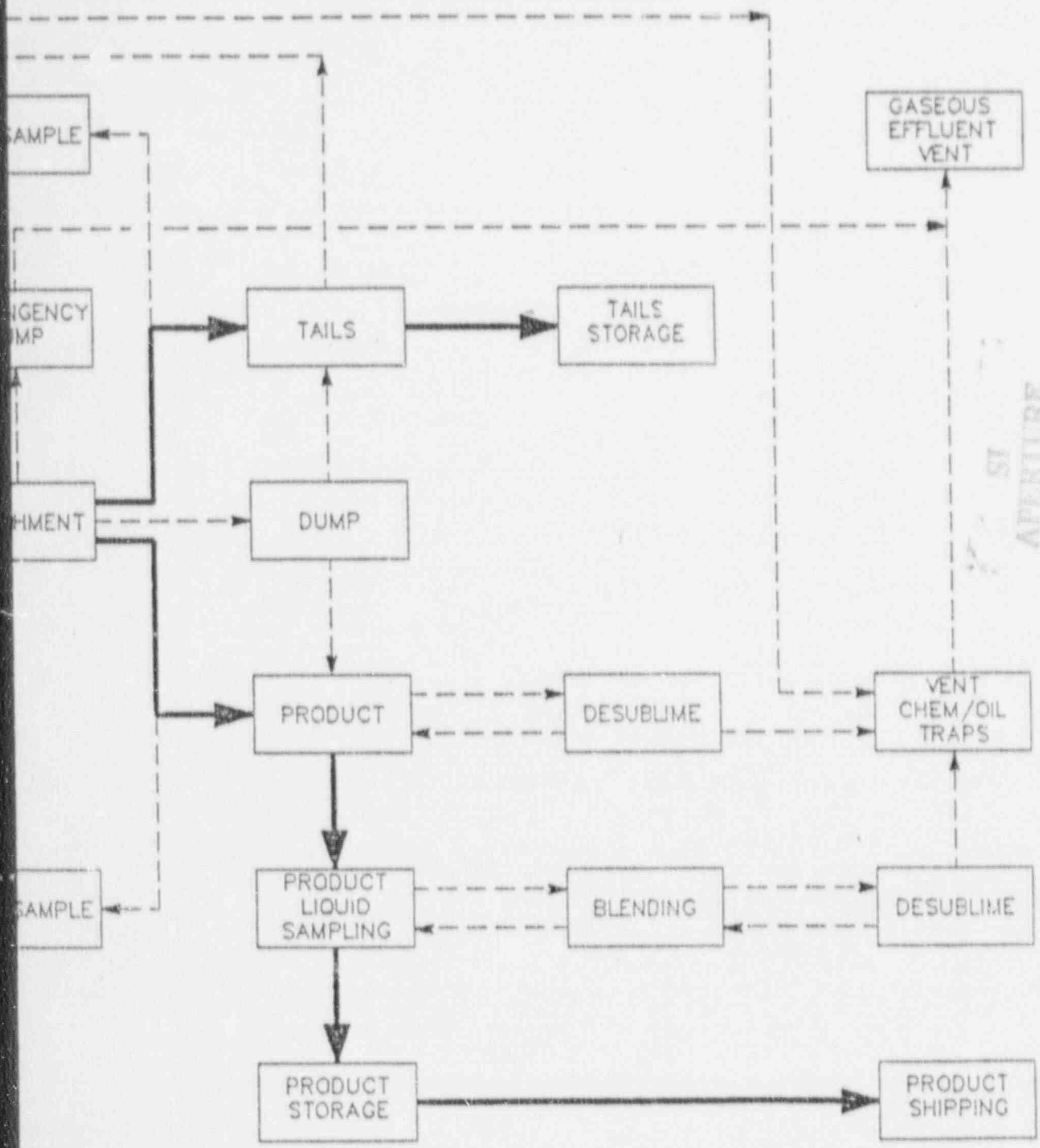
$$UF_6 + 2NiO \rightarrow UO_2F_2(s) + Ni*F_2(s)$$
$$UF_6 + Ni(OH)_2 \rightarrow UO_2F_2(s) + NiF_2(s) + 2HF$$

- UF_6 oxidizes metals, for example:

$$2UF_6 + Ni \rightarrow 2UF_5 + NiF_2$$

The reaction of UF_6 with nickel, copper and aluminum produces a protective fluoride film which slows or stops the reaction.


DESUBLIME
PURIFICATION CYLINDER
UF6 RECEIVING
PURIFICATION
FEED
GAS SAMPLE
LEGEND
PRIMARY FUNCTIONS
SECONDARY FUNCTIONS

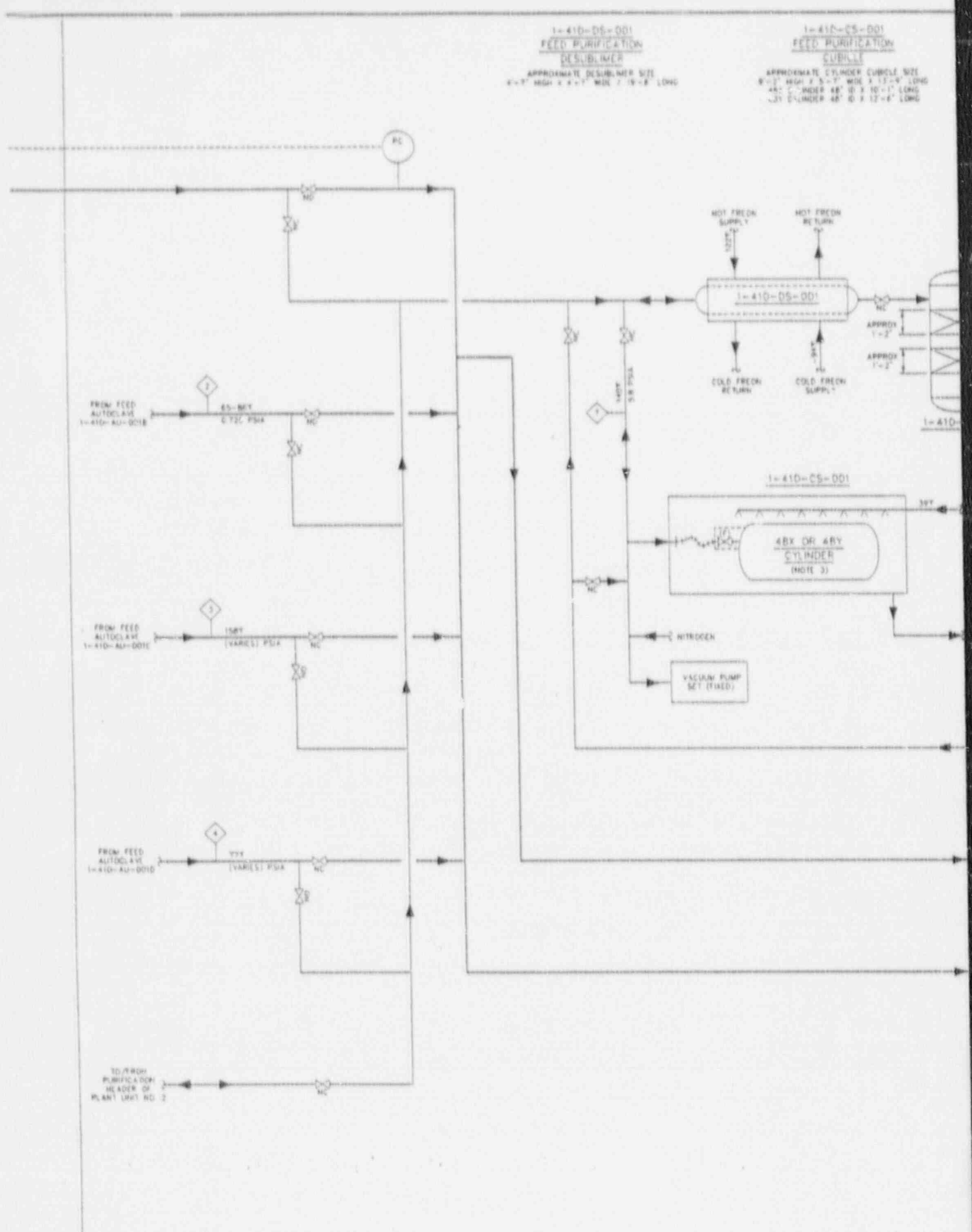


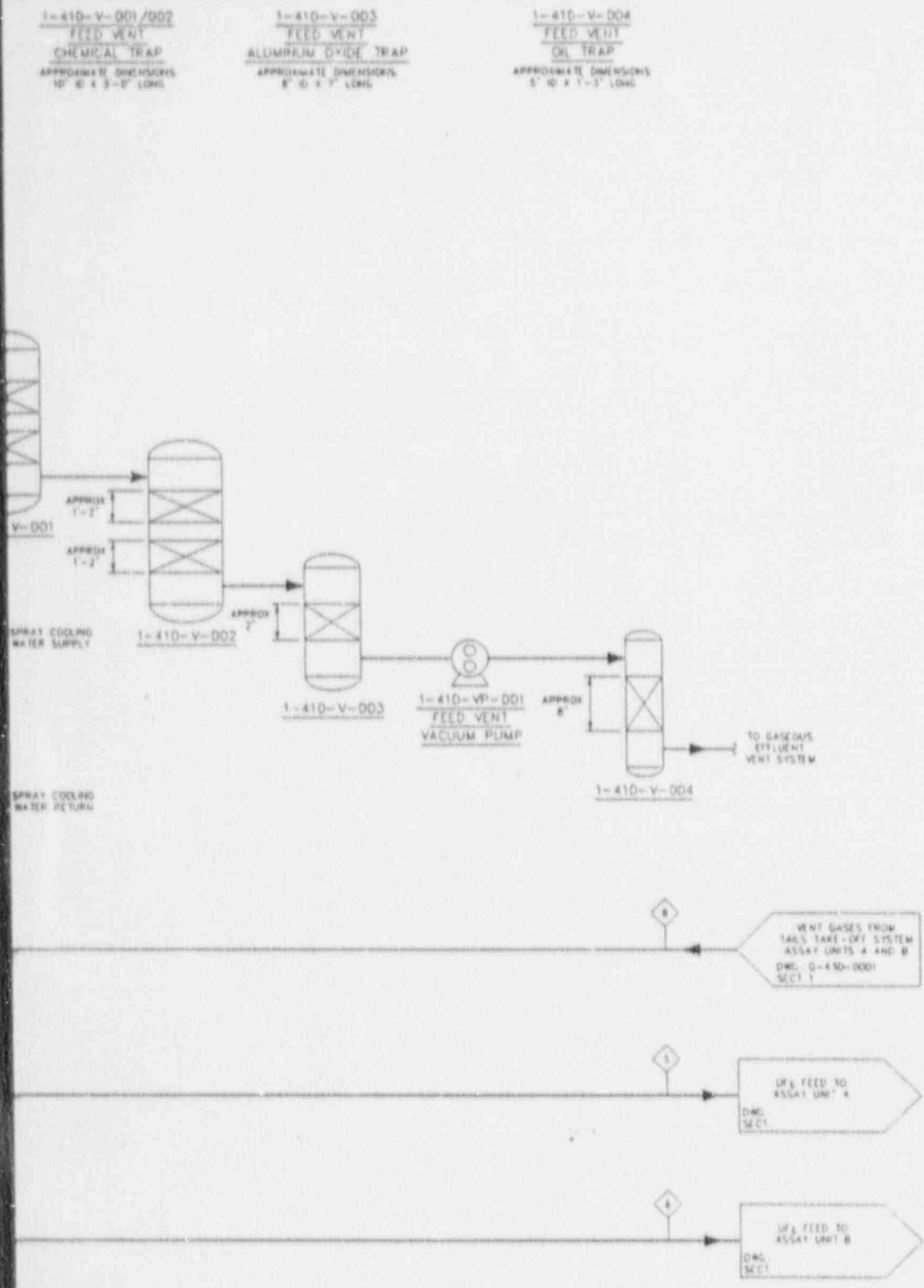
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

PROCESS SYSTEM FUNCTIONAL BLOCK DIAGRAM

Figure 3.2-1

9102060114-10


1-410-DS-001
FEED PURIFICATION
DESUBLIMER
APPROXIMATE DESUBLIMER SIZE
FEED PURIFICATION
CUBICLE
APPROXIMATE CYLINDER CUBICLE SIZE
PC
MO
HOT FREON
SUPPLY
HOT FREON
RETURN
1-410-DS-001
COLD FREON
RETURN
COLD FREON
SUPPLY
APPROX
NC
FROM FEED
AUTOCLAVE
1-410-AU-001B
1-410-CS-001
48X OR 48Y
CYLINDER
(NOTE 3)
NITROGEN
VACUUM PUMP
SET (FIXED)
FROM FEED
AUTOCLAVE
1-410-AU-001C
(VARIES) PSIA
FROM FEED
AUTOCLAVE
1-410-AU-001D
(VARIES) PSIA
TO/FROM
PURIFICATION
HEADER OF
PLANT UNIT NO. 2



NOTES

1. THE L.E.S. PLANT IS COMPOSED OF 3 PARALLEL ENRICHMENT TRAINS TITLED "PLANT UNITS". THERE ARE 2 PARALLEL ASSAY UNITS WITHIN EACH PLANT UNIT. AN ASSAY UNIT IS A GROUP OF CASCADES. THERE ARE 7 PARALLEL CASCADES IN AN ASSAY UNIT. A CASCADE IS COMPRISED OF CENTRIFUGE MACHINES CONNECTED IN A CERTAIN CONFIGURATION TO PRODUCE A GIVEN ISOTOPE SEPARATION. PLANT UNITS ARE LABELLED 1, 2, AND 3. ASSAY UNITS ARE LABELLED A, B, C, D, E, AND F.

2. THIS DRAWING DEPICTS THE FLOW SCHEME FOR PLANT UNIT 1. PLANT UNITS 2 AND 3 ARE IDENTICAL EXCEPT THAT PLANT UNIT 2 PURIFICATION HEADER CONNECTS TO BOTH PLANT UNITS 1 AND 3.

3. CYLINDER FURNISHED BY OTHERS. (F) VALVE IS PART OF CYLINDER.

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9102060114-11

DWG NO G-410-0001	REV 0	FRAME 1 OF 2

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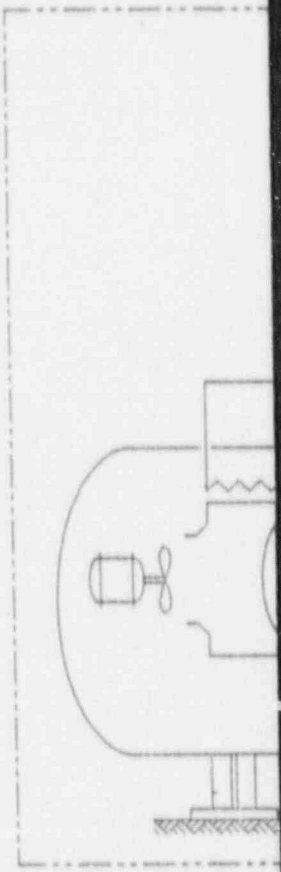
LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
UF6 FEED SYSTEM

Figure 3.2-2



MATERIAL BALANCE – PLANT UNIT NO. 1

STREAM NUMBER	1	2	3	4	5	6	7	8
STREAM DESCRIPTION	FEED LINE FROM AUTOCLAVE A (SEE NOTE 4)	FEED LINE FROM AUTOCLAVE B (SEE NOTE 4)	FEED LINE FROM AUTOCLAVE C (SEE NOTE 5)	FEED LINE FROM AUTOCLAVE D (SEE NOTE 6)	FEED TO ASSAY UNIT A	FEED TO ASSAY UNIT B	UF_6 FROM DESUBLIMER TO PURIFICATION CUBICLE	VENT GASES FROM TAILS TAKE-OFF SYSTEM ASSAY UNITS A & B (SEE NOTE 7)
UF_6 (LB MOLE/HR)	1.47	-	-	-	0.788	0.682	0.33	-
HF (LB MOLE/HR)	1.47 E-03	-	-	-	7.89 E-04	6.83 E-04	-	-
AIR (LB MOLE/HR)	TRACE	-	-	-	TRACE	TRACE	-	-
TOTAL FLOWRATE (LB MOLE/HR)	1.47	-	-	-	0.789	0.683	0.33	-
TOTAL FLOWRATE (LB/HR)	518	-	-	-	278	240	115	-
MOLECULAR WEIGHT (LB/LB MOLE)	352	-	-	-	352	352	352	-
SPECIFIC GRAVITY (LIQUID)	-	-	-	-	-	-	-	-
VAPOR DENSITY (LB/FT^3)	0.039	-	-	-	0.039	0.039	0.322	-
LIQUID FLOWRATE (GPM)	-	-	-	-	-	-	-	-
VAPOR FLOWRATE (FT^3/HR)	13280	-	-	-	7130	6150	360	-

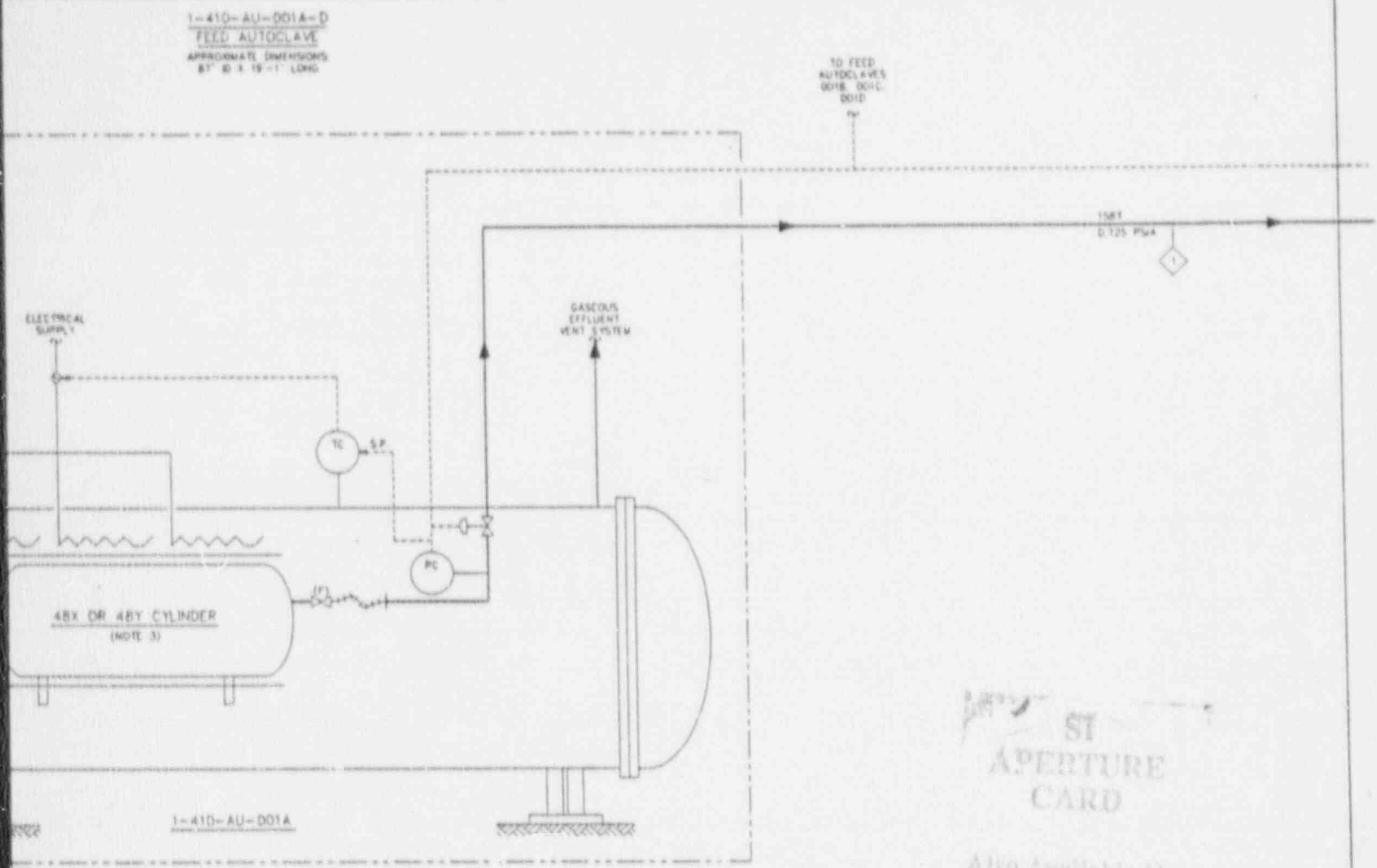
MATERIAL BALANCE – PLANT UNITS NO. 2 AND NO. 3

STREAM NUMBER	1	2	3	4	5	6	7	8
STREAM DESCRIPTION	FEED LINE FROM AUTOCLAVE A (SEE NOTE 4)	FEED LINE FROM AUTOCLAVE B (SEE NOTE 4)	FEED LINE FROM AUTOCLAVE C (SEE NOTE 5)	FEED LINE FROM AUTOCLAVE D (SEE NOTE 6)	FEED TO ASSAY UNIT C OR E	FEED TO ASSAY UNIT D OR F	UF_6 FROM DESUBLIMER TO PURIFICATION CUBICLE	VENT GASES FROM TAILS TAKE-OFF SYSTEM ASSAY UNITS A & B (SEE NOTE 7)
UF_6 (LB MOLE/HR)	1.36	-	-	-	0.682	0.682	0.33	-
HF (LB MOLE/HR)	1.36 E-03	-	-	-	6.83 E-04	6.83 E-04	-	-
AIR (LB MOLE/HR)	TRACE	-	-	-	TRACE	TRACE	-	-
TOTAL FLOWRATE (LB MOLE/HR)	1.36	-	-	-	0.683	0.683	0.33	-
TOTAL FLOWRATE (LB/HR)	481	-	-	-	240	240	115	-
MOLECULAR WEIGHT (LB/LB MOLE)	352	-	-	-	352	352	352	-
SPECIFIC GRAVITY (LIQUID)	-	-	-	-	-	-	-	-
VAPOR DENSITY (LB/FT^3)	0.039	-	-	-	0.039	0.039	0.322	-
LIQUID FLOWRATE (GPM)	-	-	-	-	-	-	-	-
VAPOR FLOWRATE (FT^3/HR)	12330	-	-	-	6150	6150	360	-

6

MATERIAL BALANCE NOTES:

1. FOR MATERIAL BALANCE PURPOSES, THE NOMINAL OPE ARE TAKEN TO BE 260 METRIC TONS SWU PER YEAR UNIT "A" PRODUCES A PRODUCT/TAILS ASSAY OF 2.0 ASSAY UNITS "B" THROUGH "F" PRODUCE A PRODUCT 2.5 WT%/0.34 WT%. ALL TEMPERATURES, PRESSURES, AND COMPOSITIONS ARE FOR PROCESS DESIGN PURPO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR SUPPLEMENTAL DESIGN INFORMATION IS CONTAINED IN BASIS, SDB-410.
2. HF FLOWRATES SHOWN ARE 0.1 MOLE%, WHICH IS A M
3. THE UPPER MATERIAL BALANCE DEPICTS THE FLOWS F THE LOWER MATERIAL BALANCE DEPICTS THE FLOW FO UNIT 2 OR 3.
4. AUTOCLAVE 1-410-AU-001A IS ON-LINE. AUTOCLAVE IN A STANDBY MODE.
5. AUTOCLAVE 1-410-AU-001C IS HOT PURIFYING ITS U PURIFICATION IS A BATCH OPERATION IN WHICH COND NO OPERATING CONDITIONS ARE LISTED.
6. AUTOCLAVE 1-410-AU-001D IS COLD PURIFYING ITS U PURIFICATION IS A BATCH OPERATION IN WHICH COND NO OPERATING CONDITIONS ARE LISTED.
7. NORMALLY NO FLOW IN THIS LINE. VENT GASES FROM IS INTERMITTENT OPERATION.



RATING CONDITIONS
PER ASSAY UNIT. ASSAY
WT%/0.34 WT% AND
TAILS ASSAY OF
FLOW QUANTITIES
ES ONLY. NO
MPLIED.
THE SYSTEM DESIGN

AXIMUM.

OR PLANT UNIT 1.
EITHER PLANT

1-410-AU-001B IS

$_6$ CYLINDER. SINCE CYLINDER
IONS ARE CONSTANTLY VARYING.

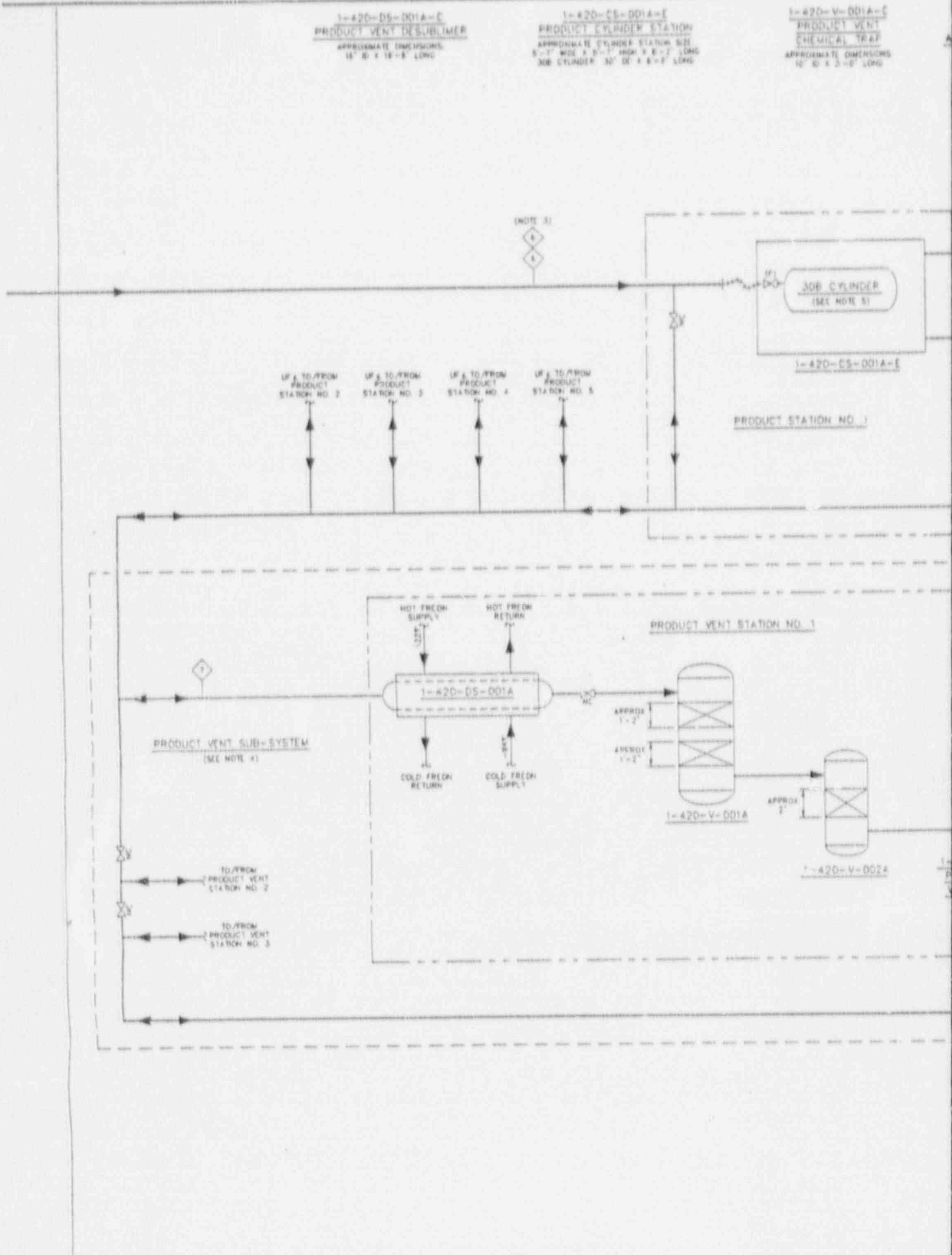
F_6 CYLINDER. SINCE CYLINDER
IONS ARE CONSTANTLY VARYING.

THE TAILS TAKE-OFF SYSTEM

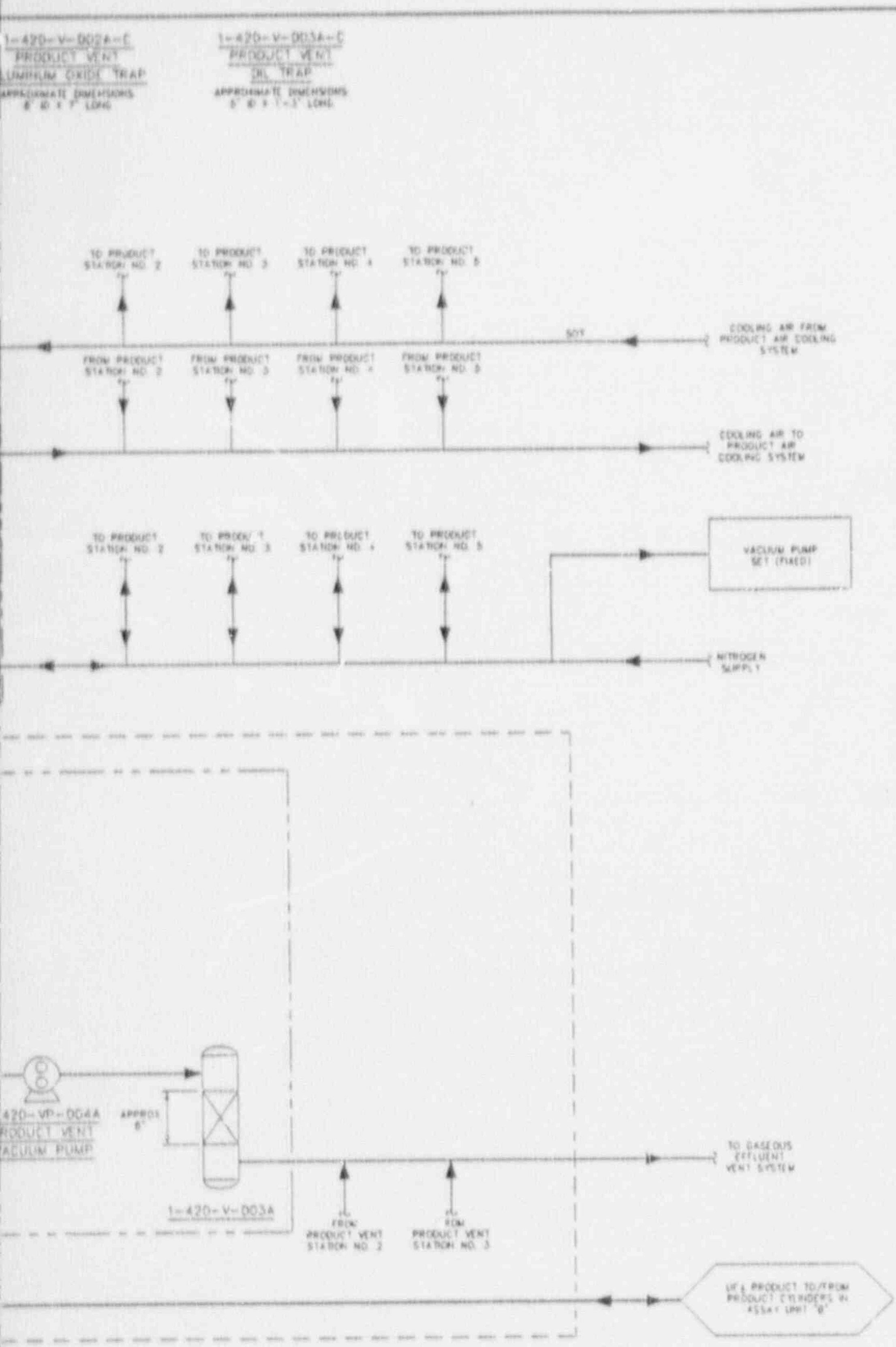
9102060114 -12

Figure 3.2-2		
DRAWING NO.	REV	FRAME
G-410-0001	1	2 OF 2

5 4


1-420-DS-001A-C
PRODUCT VENT DESUBLIMER
APPROXIMATE DIMENSIONS
1-420-CS-001A-E
PRODUCT CYLINDER STATION
APPROXIMATE CYLINDER STATION SIZE
1-420-V-001A-C
PRODUCT VENT
CHEMICAL TRAP
APPROXIMATE DIMENSIONS
(NOTE 3)
30B CYLINDER
(SEE NOTE 5)
1-420-CS-001A-E
UF6 TO/FROM PRODUCT STATION NO. 2
UF6 TO/FROM PRODUCT STATION NO. 3
UF6 TO/FROM PRODUCT STATION NO. 4
UF6 TO/FROM PRODUCT STATION NO. 5
PRODUCT STATION NO. 1
HOT FREON SUPPLY
HOT FREON RETURN
PRODUCT VENT STATION NO. 1
1-420-DS-001A
NC
APPROX 1'-2"
APPROX 1'-2"
APPROX 2"
PRODUCT VENT SUB-SYSTEM
(SEE NOTE 4)
COLD FREON RETURN
COLD FREON SUPPLY
1-420-V-001A
1-420-V-002A
TO/FROM PRODUCT VENT STATION NO. 2
TO/FROM PRODUCT VENT STATION NO. 3

3



SI
APERTURE
CARD

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NOTES:

1. THE L.E.S. PLANT IS COMPOSED OF 3 PARALLEL ENRICHMENT TRAINS TITLED "PLANT UNITS". THERE ARE 2 PARALLEL ASSAY UNITS WITHIN EACH PLANT UNIT. AN ASSAY UNIT IS A GROUP OF CASCADES. THERE ARE 7 PARALLEL CASCADES IN AN ASSAY UNIT. A CASCADE IS COMPRISED OF CENTRIFUGE MACHINES CONNECTED IN A CERTAIN CONFIGURATION TO PRODUCE A GIVEN ISOTOPE SEPARATION. PLANT UNITS ARE LABELED 1, 2, AND 3. ASSAY UNITS ARE LABELED A, B, C, D, E, AND F.

   THE CASCADES OF ASSAY UNITS "B" THROUGH "F" ARE IDENTICAL IN CONFIGURATION. THESE ASSAY UNITS ARE CONSIDERED INDISTINGUISHABLE IN TERMS OF UF_6 FLOW RATES AND THE DEGREE OF ISOTOPE SEPARATION (THEY HAVE IDENTICAL MATERIAL BALANCES). THE CASCADES OF ASSAY UNIT "A" ARE CONFIGURED DIFFERENTLY SUCH THAT ASSAY "A" PRODUCES A DIFFERENT ISOTOPE SEPARATION AND HAS DIFFERENT UF_6 FLOW RATES THAN THE OTHER ASSAYS.

2. THIS DRAWING DEPICTS THE FLOW SCHEME FOR ONE OF SIX PARALLEL "PRODUCT TAKE-OFF SYSTEM" ASSAY UNITS.

3. THERE ARE THREE PRODUCT STATIONS ON-LINE AT ANY GIVEN TIME. IN ACTUALITY THE FLOW RATE TO A GIVEN CYLINDER FROM THE TERTIARY HEADER WILL VARY DEPENDING ON SEVERAL FACTORS, AND MAY BE DIFFERENT FROM THE FLOW RATES TO THE OTHER TWO ON-LINE CYLINDERS. THE FLOW RATES SHOWN FOR THIS STREAM ARE ARBITRARILY SET AT 1/3 OF THE TOTAL PRODUCT FLOW.

4. THE "PRODUCT VENT SUB-SYSTEM" IS COMMON TO TWO "PRODUCT TAKE-OFF SYSTEM" ASSAY UNITS. VENT STATION NO. 2 IS A COMMON SPARE TRAIN FOR VENT STATION NO. 1 AND NO. 3.

5. CYLINDER FURNISHED BY OTHERS. (F) VALVE PART OF THE CYLINDER.

DWG NO G-420-0001	REV 0	FRAME 1 OF 2

FLUOR DANIEL
ADVANCED TECHNOLOGY DIVISION

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

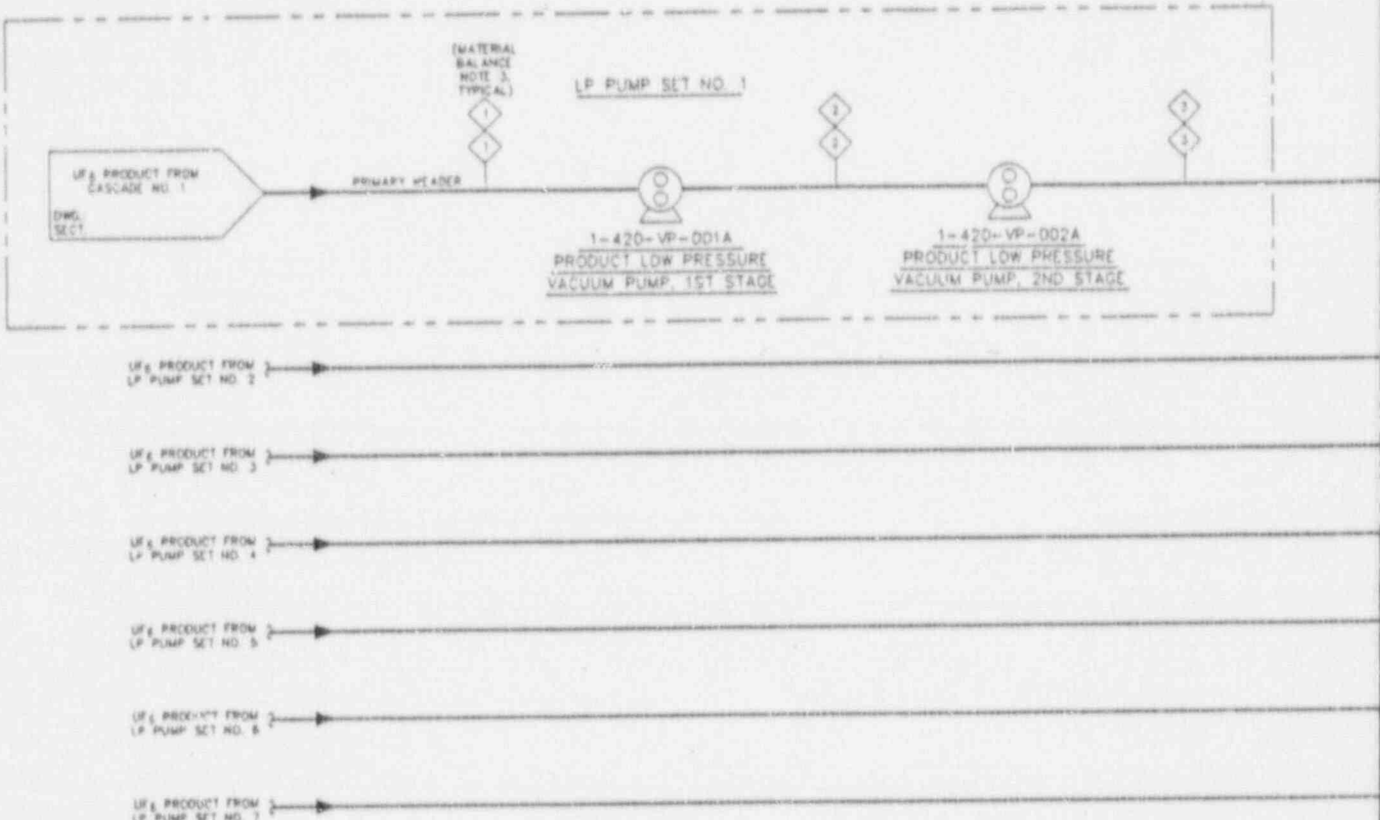
PROCESS FLOW DIAGRAM
PRODUCT TAKE-OFF SYSTEM

Figure 3.2-3

9102060114 -13

ACAD DF+ER323

2 | 1



ASSAY UNIT "A"

STREAM NUMBER	1	2	3	4	5	6	7
STREAM DESCRIPTION	INLET TO LP PUMP NO. 1	PRODUCT FROM 1ST STAGE LP VACUUM PUMP CASCADE NO. 1	PRODUCT FROM 2ND STAGE LP VACUUM PUMP CASCADE NO. 1	TOTAL PRODUCT FLOW	TOTAL PRODUCT FROM HP VACUUM PUMP	PRODUCT TO PRODUCT CYLINDER	PRODUCT FROM DESUBLIMER TO PRODUCT CYLINDER
PRESSURE (PSIA)	0.0150	0.115	0.375	0.517	6.38	6.24	5.8
TEMPERATURE (°F)	77	77 (NOTE 2)	77	77	140	140	140
UF_6 (LB MOLE/HR)	0.0251	0.0351	0.0251	0.175	0.175	0.0585	0.0814
HF (LB MOLE/HR)	1.13 E-04	1.13 E-04	1.13 E-04	7.89 E-04	7.89 E-04	2.63 E-04	-
AIR (LB MOLE/HR)	3.15 E-06	3.15 E-06	3.15 E-06	2.21 E-05	2.21 E-05	7.36 E-06	-
TOTAL FLOWRATE (LB MOLE/HR)	0.0252	0.0252	0.0252	0.176	0.176	0.0587	0.0814
TOTAL FLOWRATE (LB/HR)	8.82	8.82	8.82	61.7	61.7	20.6	28.7
MOLECULAR WEIGHT (LB/LB MOLE)	350	350	350	350	350	350	352
SPECIFIC GRAVITY (LIQUID)	-	-	-	-	-	-	-
VAPOR DENSITY (LB/FT3)	9.11 E-04	7.02 E-03	3.50 E-02	3.15 E-02	0.347	0.340	0.317
LIQUID FLOWRATE (GPM)	-	-	-	-	-	-	-
VAPOR FLOWRATE (FT3/HR)	9680	1260	252	1960	178	60.6	90.4

ASSAY UNITS "B" THROUGH "F"

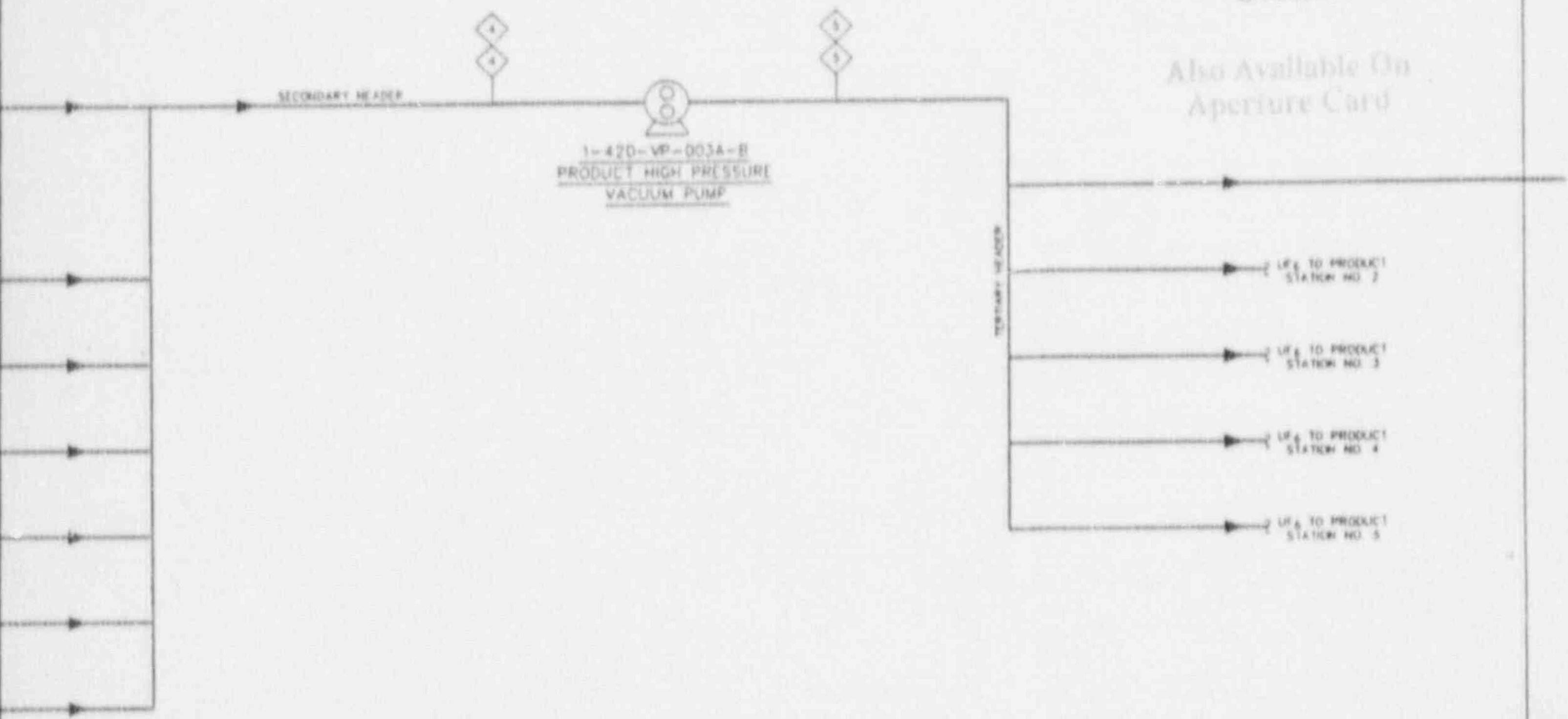
STREAM NUMBER	1	2	3	4	5	6	7
STREAM DESCRIPTION	INLET TO LP PUMP NO. 1	PRODUCT FROM 1ST STAGE LP VACUUM PUMP CASCADE NO. 1	PRODUCT FROM 2ND STAGE LP VACUUM PUMP CASCADE NO. 1	TOTAL PRODUCT FLOW	TOTAL PRODUCT FROM HP VACUUM PUMP	PRODUCT TO PRODUCT CYLINDER	PRODUCT FROM DESUBLIMER TO PRODUCT CYLINDER
PRESSURE (PSIA)	0.0104	0.0918	0.512	0.486	6.30	6.24	5.8
TEMPERATURE (°F)	77	77 (NOTE 2)	77	77	140	140	140
UF_6 (LB MOLE/HR)	0.0170	0.0170	0.0170	0.119	0.119	0.0397	0.0814
HF (LB MOLE/HR)	9.75 E-05	9.75 E-05	9.75 E-05	6.83 E-04	6.83 E-04	2.28 E-04	-
AIR (LB MOLE/HR)	3.15 E-06	3.15 E-06	3.15 E-06	2.21 E-05	2.21 E-05	7.36 E-06	-
TOTAL FLOWRATE (LB MOLE/HR)	0.0171	0.0171	0.0171	0.120	0.120	0.0399	0.0814
TOTAL FLOWRATE (LB/HR)	5.99	5.99	5.99	41.9	41.9	14.0	28.7
MOLECULAR WEIGHT (LB/LB MOLE)	350	350	350	350	350	350	352
SPECIFIC GRAVITY (LIQUID)	-	-	-	-	-	-	-
VAPOR DENSITY (LB/FT3)	6.32 E-04	5.58 E-03	3.11 E-02	2.95 E-02	0.341	0.339	0.317
LIQUID FLOWRATE (GPM)	-	-	-	-	-	-	-
VAPOR FLOWRATE (FT3/HR)	948L	1070	192	1420	122	41.2	90.4

MATERIAL BALANCE NOTES:

1. STREAM INFORMATION REPRESENTS NOMINAL OPERATING CONDITIONS WHICH ARE TAKEN TO BE 260 METRIC TONS SWU PER YEAR PER ASSAY UNIT. ASSAY UNIT "A" PRODUCES A PRODUCT/TAILS ASSAY OF 2.0 WT%/0.34 WT% AND ASSAY UNITS B THROUGH F PRODUCES A PRODUCT/TAILS ASSAY OF 2.5 WT%/0.34 w/%. ALL TEMPERATURES, PRESSURES, FLOW QUANTITIES, AND COMPOSITIONS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-420.

2. TEMPERATURE WILL BE GREATER THAN THIS VALUE.

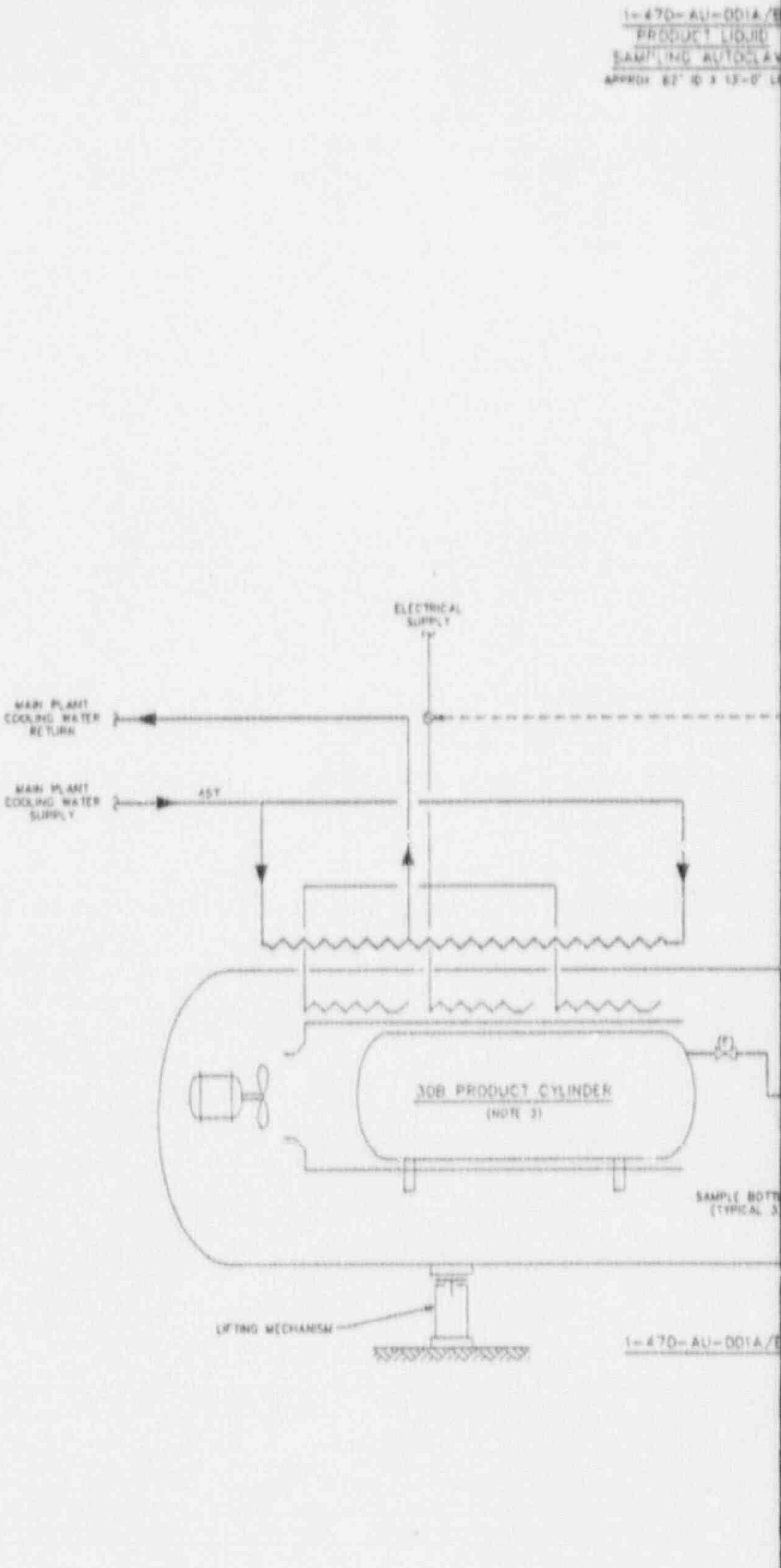
3. THE UPPER STREAM TAG IDENTIFIERS REFLECT THE STREAM CONDITIONS FOR ASSAY UNIT "A", WHILE THE LOWER STREAM TAG IDENTIFIERS REFLECT THE STREAM CONDITIONS FOR ONE ASSAY UNIT OF UNITS "B" THROUGH "F". IF A GIVEN STREAM HAS ONLY ONE TAG IDENTIFIER, THEN THE STREAM CONDITION INFORMATION PRESENTED IS REPRESENTATIVE OF EACH OF THE ASSAY UNITS.



9102060114-14

Figure 3.2-3		
DRAWING NO.	REV	FRAME
C-420-0001	0	2 OF 2

5 1 4

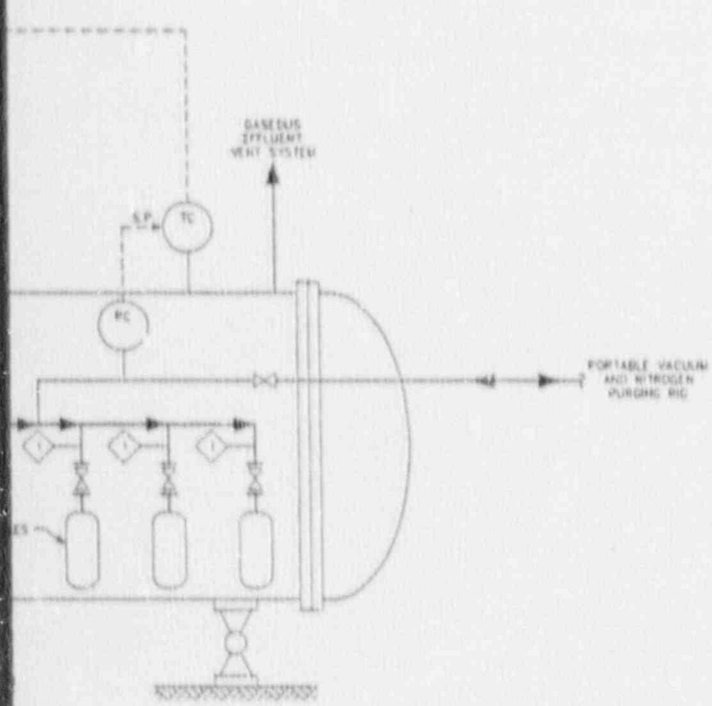


STREAM NUMBER	1
STREAM DESCRIPTION	LIQUID UF_6 TO SAMPLE BOTTLE
PRESSURE (PSIA)	36.3
TEMPERATURE (°F)	176
UF_6 (LB)	1.0
UF_6 (LB MOLE)	2.84 E-03
MOLECULAR WEIGHT (LB/LB MOLE)	352
SPECIFIC GRAVITY (LIQUID)	3.53

MATERIAL BALANCE NOTES:

1. ALL TEMPERATURES, PRESSURES, FLOW QUANTITIES AND COMPOSITIONS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-470.

3



NOTES:

1. THE L.E.S. PLANT IS COMPOSED OF 3 PARALLEL ENRICHMENT TRAINS TITLED "PLANT UNITS". THERE ARE 2 PARALLEL ASSAY UNITS WITHIN EACH PLANT UNIT. AN ASSAY UNIT IS A GROUP OF CASCADES. THERE ARE 7 PARALLEL CASCADES IN AN ASSAY UNIT. A CASCADE IS COMPRISED OF CENTRIFUGE MACHINES CONNECTED IN A CERTAIN CONFIGURATION TO PROVIDE A GIVEN ISOTOPE SEPARATION. PLANT UNITS ARE LABELED 1, 2, AND 3. ASSAY UNITS ARE LABELED A, B, C, D, E, AND F.

2. THIS DRAWING DEPICTS THE PRODUCT LIQUID SAMPLING SYSTEM FOR PLANT UNIT 1. PLANT UNITS 2 AND 3 ARE IDENTICAL.

3. CYLINDER FURNISHED BY OTHERS. (F) VALVE IS PART OF THE CYLINDER.

DWG. NO. D-470-0001	REV. 0	FRAME 1 OF 1

FLUOR DANIEL

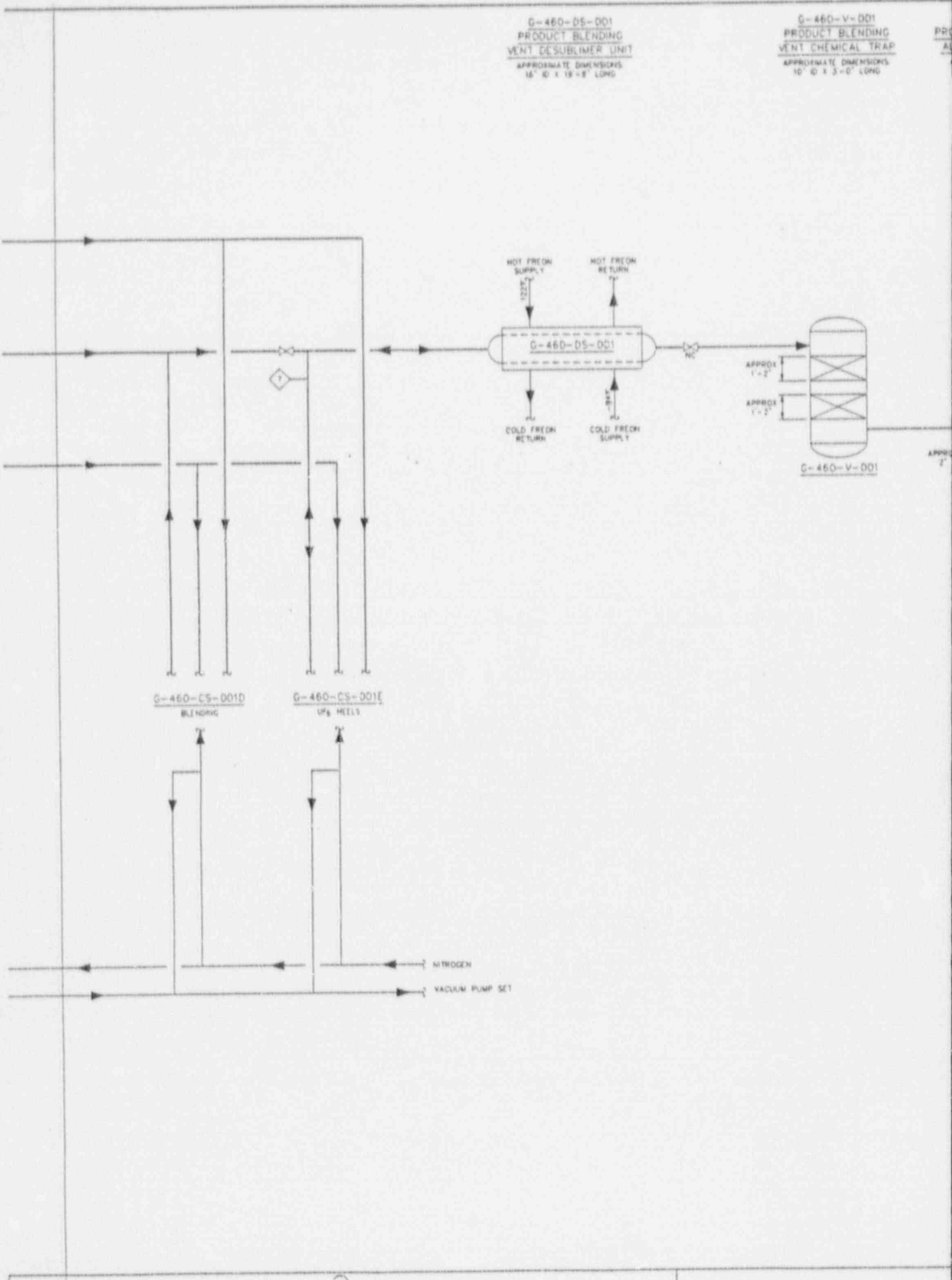
LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
PRODUCT LIQUID
SAMPLING SYSTEM
Figure 3.2-4

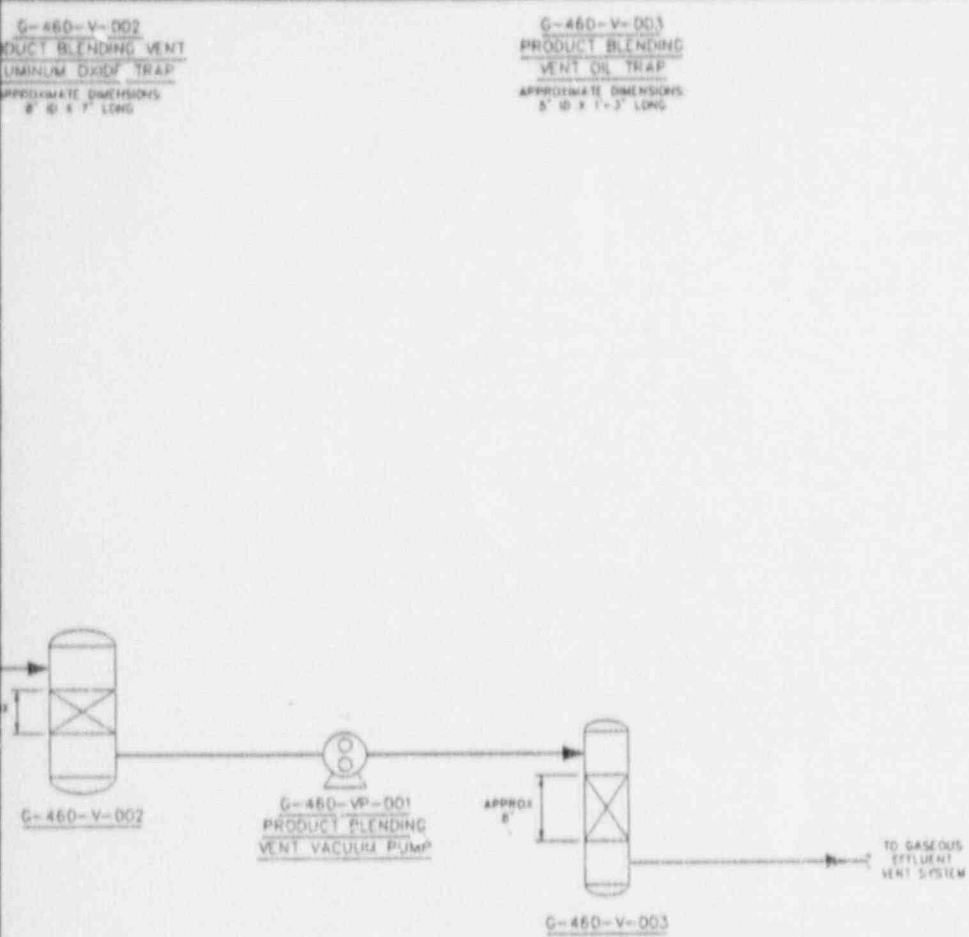
9102060114-15

2 | 1 | 1

ACAD DF=ER3/4



G-460-DS-001
PRODUCT BLENDING
VENT DESUBLIMER UNIT
G-460-V-001
PRODUCT BLENDING
VENT CHEMICAL TRAP
HOT FREON SUPPLY
HOT FREON RETURN
G-460-DS-001
COLD FREON RETURN
COLD FREON SUPPLY
NC
APPROX 1'-2"
APPROX 1'-2"
G-460-V-001
G-460-CS-001D
BLENDING
G-460-CS-001E
UF6 HEELS
NITROGEN
VACUUM PUMP SET



NOTES

1. THE CES PLANT IS COMPOSED OF 3 PARALLEL ENRICHMENT TRAINS TITLED "PLANT UNITS". THERE ARE 2 PARALLEL ASSAY UNITS WITHIN EACH PLANT UNIT. A CENTRAL BLENDING SYSTEM DEPICTED ON THIS DRAWING HAS THE CAPABILITY TO FULFILL THE BLENDING NEEDS OF THE ENTIRE ENRICHMENT FACILITY.

2. CYLINDER FURNISHED BY OTHERS. (F) VALVE IS PART OF THE CYLINDER.

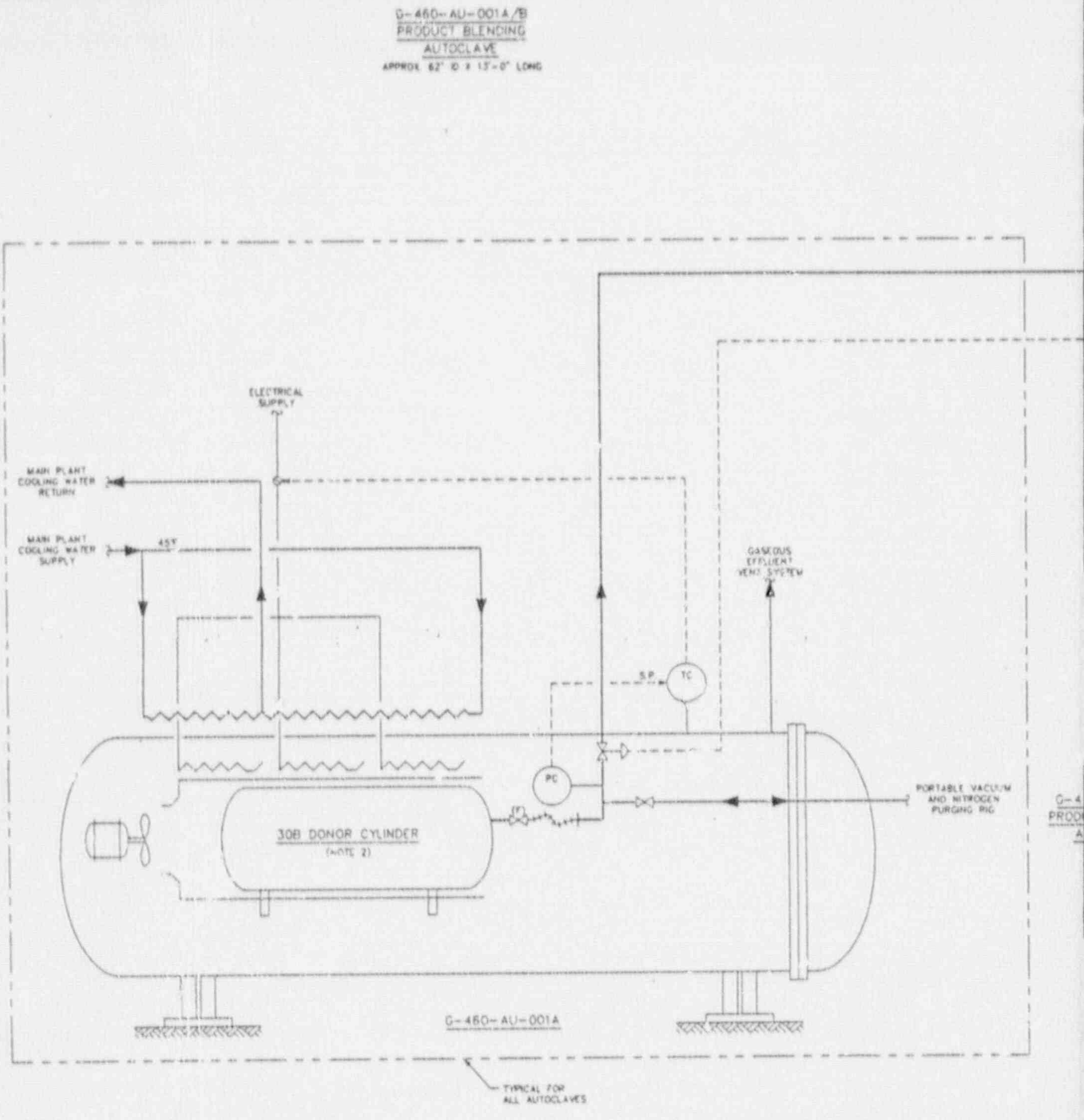
DWG. NO. G-460-D001	REV. 0	FRAME 1 OF 2

FLUOR DANIEL

LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
PRODUCT BLENDING SYSTEM

Figure 3.2-5



STREAM NUMBER	1	2	3	4	5	6	7
STREAM DESCRIPTION	UF_6 GAS FROM AUTOCLAVE "A" TO TRANSFER LINE 1	UF_6 GAS FROM AUTOCLAVE "B" TO TRANSFER LINE 2	PRODUCT DISCHARGE LINE FROM AUTOCLAVE "A" (NOTE 2 & 3)	PRODUCT DISCHARGE LINE FROM AUTOCLAVE "B" (NOTE 2 & 3)	UF_6 GAS FROM TRANSFER LINE 1 TO RECEIVER CYLINDER	UF_6 GAS FROM TRANSFER LINE 2 TO RECEIVER CYLINDER	HEEL GAS FROM DESUBLIMER TO HEEL RECEIVER
PRESSURE (PSIA)	11.6	11.6	–	–	11.6	11.6	5.8
TEMPERATURE (°F)	176	176	–	–	176	176	176
UF_6 (LB MOLE/HR)	0.2505	0.2505	–	–	0.1253	0.1253	0.0814
HF (LB MOLE/HR)	TRACE	TRACE	–	–	TRACE	TRACE	–
AIR (LB MOLE/HR)	TRACE	TRACE	–	–	TRACE	TRACE	–
TOTAL FLOWRATE (LB MOLE/HR)	0.2505	0.2505	–	–	0.1253	0.1253	0.0814
TOTAL FLOWRATE (LB/HR)	88.2	88.2	–	–	44.1	44.1	28.66
MOLECULAR WEIGHT (LB/LB MOLE)	352	352	–	–	352	352	352
SPECIFIC GRAVITY (LIQUID)	–	–	–	–	–	–	–
VAPOR DENSITY (LB/FT³)	0.8121	0.8121	–	–	0.8121	0.8121	0.3027
LIQUID FLOWRATE (GPM)	–	–	–	–	–	–	–
VAPOR FLOWRATE (FT³/HR)	144.1	144.1	–	–	72.0	72.0	94.7

MATERIAL BALANCE NOTES:

1. ALL TEMPERATURES, PRESSURES, FLOW QUANTITIES, AND COMPOSITIONS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-460.
2. THE PRODUCT DISCHARGE LINE IS USED FOR COLD PURIFICATION OF A CYLINDER. SINCE CYLINDER PURIFICATION IS A BATCH OPERATION IN WHICH CONDITIONS ARE CONSTANTLY VARYING, NO OPERATING CONDITIONS ARE LISTED.
3. THE PRIMARY USE OF THE PRODUCT DISCHARGE LINE IS FOR EMPTYING TRACE QUANTITIES OF UF_6 IN THE BLENDING SYSTEM INTO THE DESUBLIMER.

6

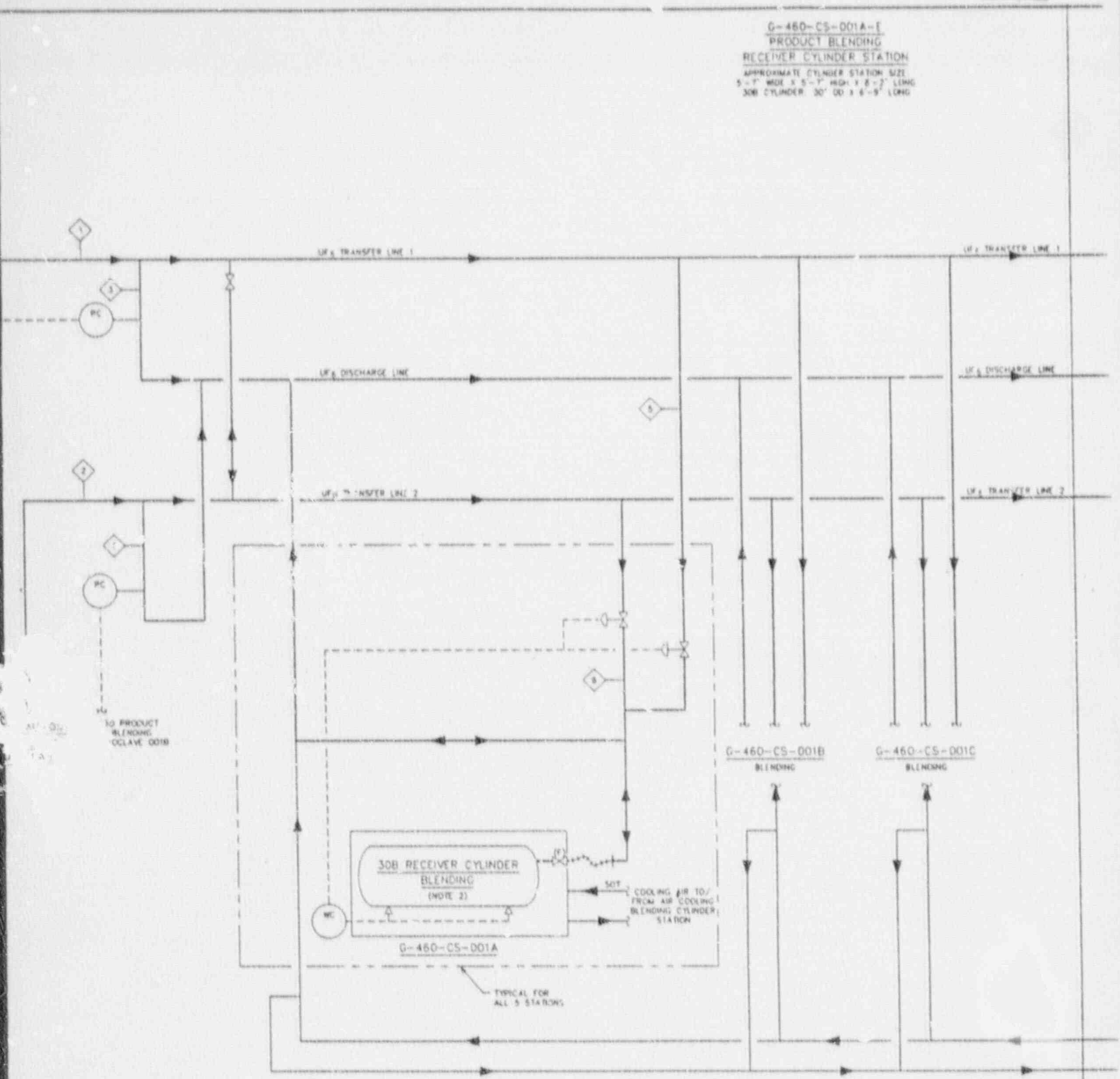
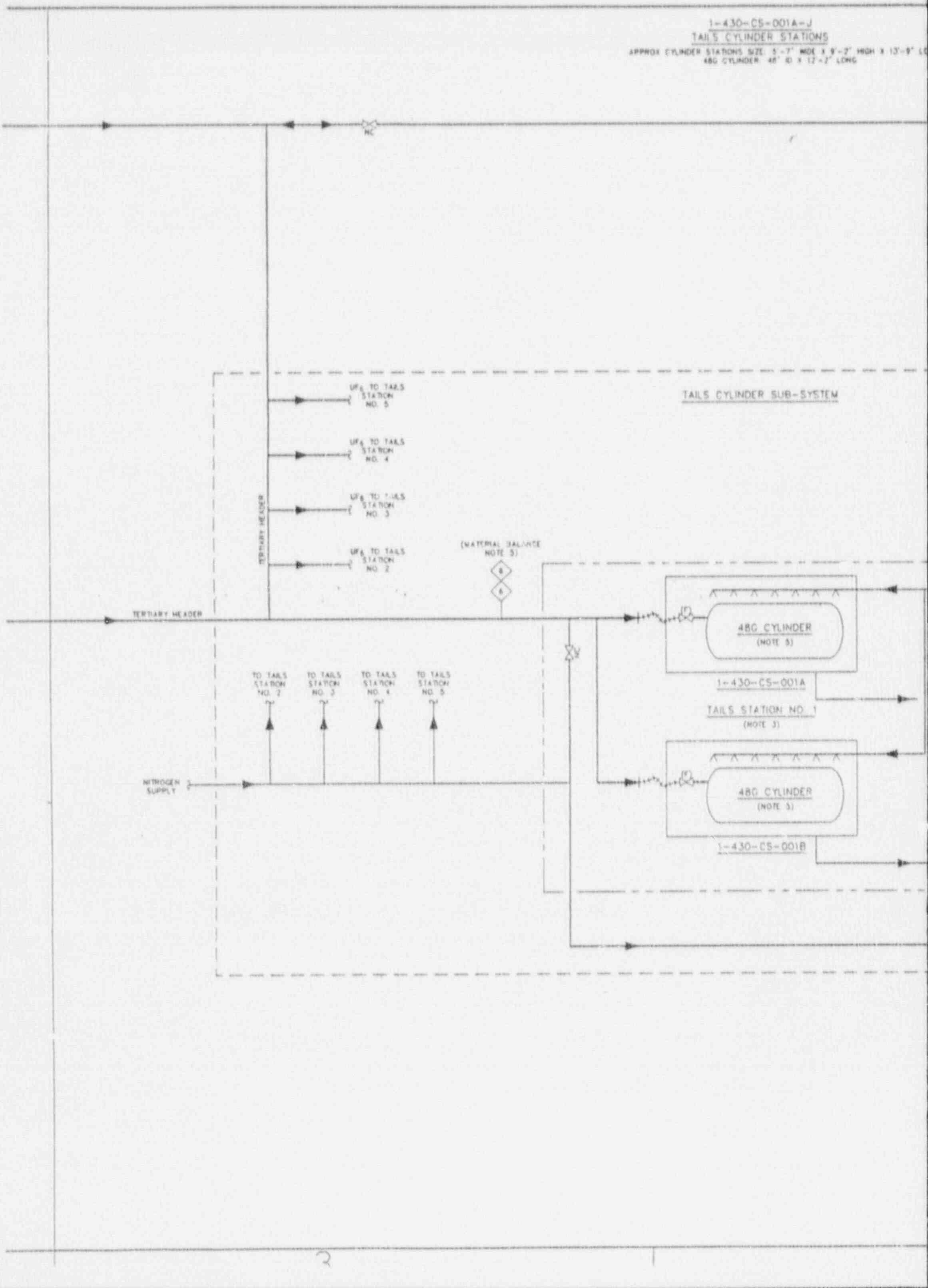
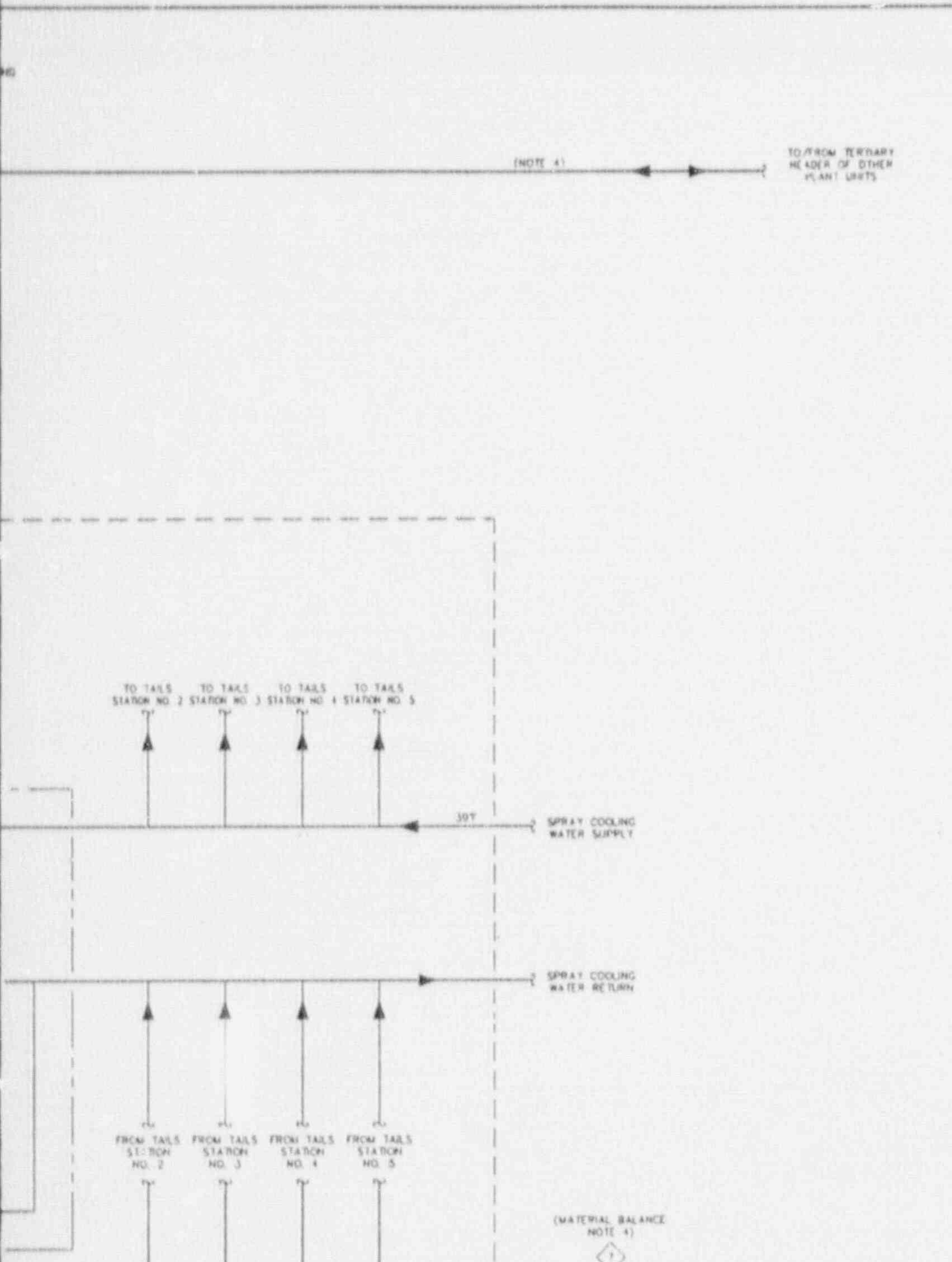


Figure 3.2-5		
DRAWING NO.	REV.	FRAME
G-460-0001	0	2 OF 2

5 4


1-430-CS-001A-J
TAILS CYLINDER STATIONS
APPROX CYLINDER STATIONS SIZE: 5'-7" WIDE X 9'-2" HIGH X 13'-9" LO
48G CYLINDER: 48" ID X 12'-2" LONG
NC
TAILS CYLINDER SUB-SYSTEM
UF6 TO TAILS STATION NO. 5
UF6 TO TAILS STATION NO. 4
UF6 TO TAILS STATION NO. 3
UF6 TO TAILS STATION NO. 2
TERTIARY HEADER
(MATERIAL BALANCE NOTE 5)
TERTIARY HEADER
48G CYLINDER
(NOTE 5)
1-430-CS-001A
TAILS STATION NO. 1
(NOTE 3)
TO TAILS STATION NO. 2
TO TAILS STATION NO. 3
TO TAILS STATION NO. 4
TO TAILS STATION NO. 5
NITROGEN SUPPLY
48G CYLINDER
(NOTE 5)
1-430-CS-001B



SI APERTURE CARD

Also Available On Aperture Card

NOTES

1. THE L.E.S. PLANT IS COMPOSED OF 3 PARALLEL ENRICHMENT TRAINS TITLED "PLANT UNITS". THERE ARE 2 PARALLEL ASSAY UNITS WITHIN EACH PLANT UNIT. AN ASSAY UNIT IS A GROUP OF CASCADES. THERE ARE 7 PARALLEL CASCADES IN AN ASSAY UNIT. A CASCADE IS COMPRISED OF CENTRIFUGE MACHINES CONNECTED IN A CERTAIN CONFIGURATION TO PRODUCE A GIVEN ISOTOPE SEPARATION. PLANT UNITS ARE LABELED 1, 2, AND 3. ASSAY UNITS ARE LABELED A, B, C, D, E, AND F.

2. THIS DRAWING DEPICTS THE FLOW SCHEME FOR ONE OF THREE PARALLEL "TAILS TAKE-OFF SYSTEM" PLANT UNITS. EACH "TAILS TAKE-OFF SYSTEM" PLANT UNIT IS COMPOSED OF TWO TAILS VACUUM PUMP SUB-SYSTEMS, ONE FOR EACH ASSAY UNIT, WITH ONLY ONE TAILS CYLINDER SUB-SYSTEM. EACH TAILS VACUUM PUMP SUB-SYSTEM CONSISTS OF 14 LOW PRESSURE AND 3 HIGH PRESSURE VACUUM PUMPS. THE TAILS CYLINDER SUB-SYSTEM CONSISTS OF 5 TAILS STATIONS, EACH INCLUDING TWO TAILS CYLINDER STATIONS TO SUPPLY INTERNATIONAL 48G CYLINDERS FOR UF_6 STORAGE.

3. THERE ARE FOUR TAILS STATIONS ON-LINE AT ANY GIVEN TIME; THERE ARE TWO TAILS CYLINDERS IN EACH TAILS STATION. THE FLOW RATE TO A GIVEN CYLINDER FROM THE TERTIARY HEADER WILL VARY DEPENDING ON SEVERAL FACTORS, AND MAY BE DIFFERENT FROM THE FLOW RATE TO THE OTHER ON-LINE CYLINDERS.

4. THE FUNCTION OF THIS LINE IS TO PROVIDE FLEXIBILITY OF OPERATIONS IN THE EVENT OF SCHEDULED OR UNSCHEDULED MAINTENANCE ACTIVITIES. THERE IS NORMALLY NO FLOW.

5. CYLINDER FURNISHED BY OTHERS. (F) VALVE PART OF CYLINDER.

DWG. NO. G-430-0001 REV. 1 FRAME 1 OF 2

FLUOR DANIEL

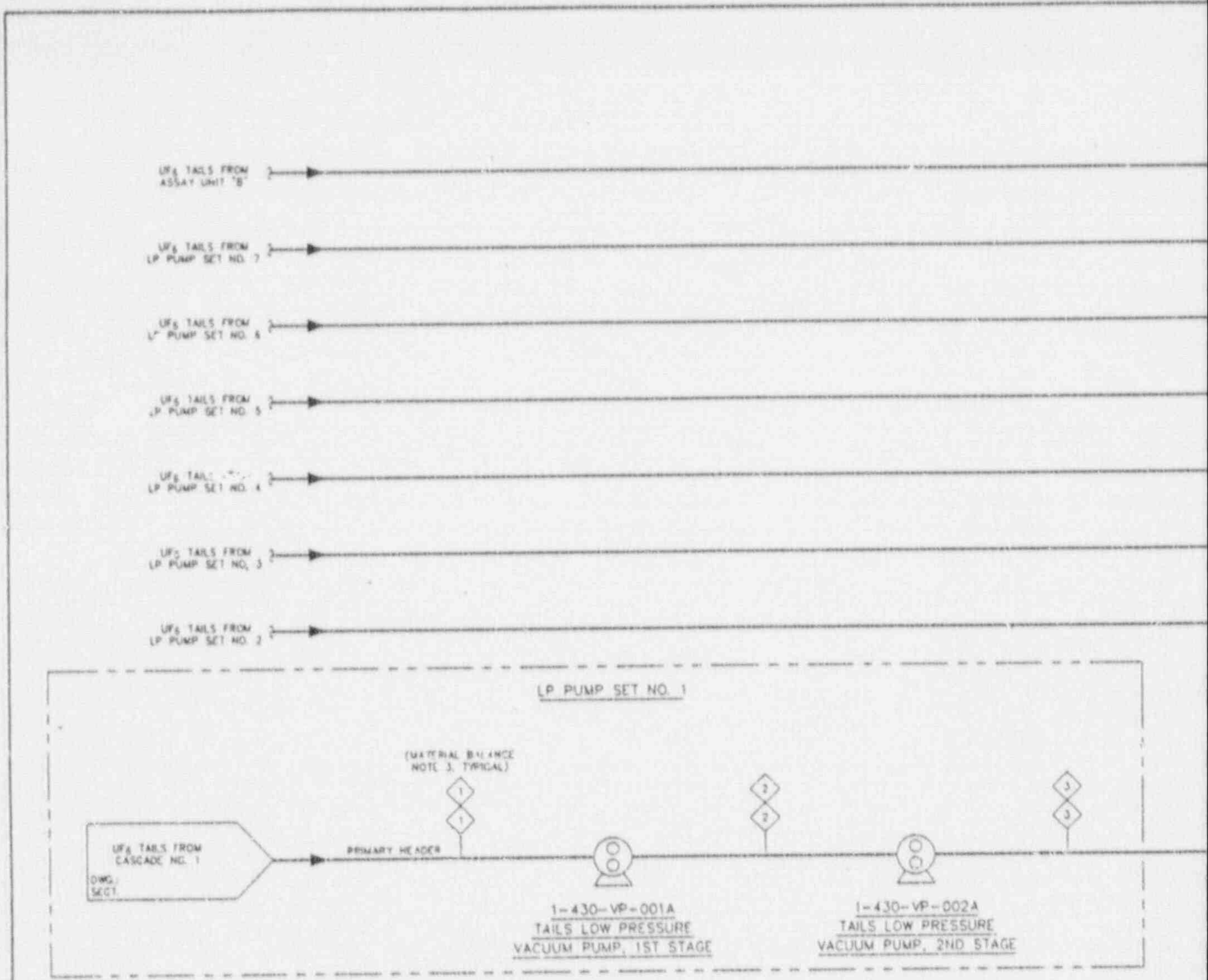
LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
TAILS TAKE-OFF SYSTEM

Figure 3.2-6

9102060114 -18

1



STREAM NUMBER	1	2	3	4	5	6	7
STREAM DESCRIPTION	INLET TO LP PUMP NO. 1	TAILS FROM 1ST STAGE LP VACUUM PUMP ASSAY UNIT A CASCADE NO. 1	TAILS FROM 2ND STAGE LP VACUUM PUMP ASSAY UNIT A CASCADE NO. 1	TOTAL TAILS FLOW ASSAY UNIT A	TOTAL TAILS FROM HP VACUUM PUMPS ASSAY UNIT A	TAILS FROM TERTIARY HEADER TO TAILS STATION NO. 1 PLANT UNIT 1	VENT GASES FROM TAILS STATIONS PLANT UNIT 1
PRESSURE (PSIA)	0.0101	0.0732	0.471	0.413	3.26	3.12	-
TEMPERATURE (°F)	77	77 (NOTE 2)	77	77	140	140	-
UF_6 (LB MOLE/HR)	0.0878	0.0878	0.0878	0.614	0.614	0.294	-
HF (LB MOLE/HR)	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	-
AIR (LB MOLE/HR)	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	-
TOTAL FLOWRATE (LB MOLE/HR)	0.0878	0.0878	0.0878	0.614	0.614	0.294	-
TOTAL FLOWRATE (LB/HR)	30.9	30.9	30.9	216.1	216.1	103.8	-
MOLECULAR WEIGHT (LB/LB MOLE)	352	352	352	352	352	352	-
SPECIFIC GRAVITY (LIQUID)	-	-	-	-	-	-	-
VAPOR DENSITY (LB/FT^3)	6[illegible] E-04	0.00448	0.0288	0.0253	0.179	0.170	-
LIQUID FLOWRATE (GPM)	-	-	-	-	-	-	-
VAPOR FLOWRATE (FT^3/HR)	50,081	6,897	1,073	8,542	1,207	609.4	-

STREAM NUMBER	1	2	3	4	5	6	7
STREAM DESCRIPTION	INLET TO LP PUMP NO. 1	TAILS FROM 1ST STAGE LP VACUUM PUMP ASSAY UNIT B CASCADE NO. 1	TAILS FROM 2ND STAGE LP VACUUM PUMP ASSAY UNIT B CASCADE NO. 1	TOTAL TAILS FLOW ASSAY UNIT B	TOTAL TAILS FROM HP VACUUM PUMPS ASSAY UNIT B	TAILS FROM TERTIARY HEADER TO TAILS STATION NO. 1 PLANT UNIT 2 OR 3	VENT GASES FROM TAILS STATIONS PLANT UNIT 2 OR 3
PRESSURE (PSIA)	0.00921	0.0674	0.445	0.396	3.24	3.12	-
TEMPERATURE (°F)	77	77 (NOTE 2)	77	77	140	140	-
UF_6 (LB MOLE/HR)	0.0804	0.0804	0.0804	0.564	0.564	0.282	-
HF (LB MOLE/HR)	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	-
AIR (LB MOLE/HR)	TRACE	TRACE	TRACE	TRACE	TRACE	TRACE	-
TOTAL FLOWRATE (LB MOLE/HR)	0.0804	0.0804	0.0804	0.564	0.564	0.282	-
TOTAL FLOWRATE (LB/HR)	28.3	28.3	28.3	198.4	198.4	99.2	-
MOLECULAR WEIGHT (LB/LB MOLE)	352	352	352	352	352	352	-
SPECIFIC GRAVITY (LIQUID)	-	-	-	-	-	-	-
VAPOR DENSITY (LB/FT^3)	5.62 E-04	0.00411	0.0272	0.0242	0.178	0.170	-
LIQUID FLOWRATE (GPM)	-	-	-	-	-	-	-
VAPOR FLOWRATE (FT^3/HR)	50,356	6,886	1,040	8,198	1,110	583.5	-

MATERIAL BALANCE NOTES:

1. FOR MATERIAL BALANCE PURPOSES, THE NOMINAL OPERATING CONDITIONS ARE TAKEN TO BE 260 METRIC TONS SWU PER YEAR PER ASSAY UNIT. ASSAY UNIT A PRODUCES A PRODUCT/TAILS ASSAY 2.0WT%/0.34WT% AND ASSAY UNITS B THROUGH F PRODUCE A PRODUCT/TAILS ASSAY OF 2.5WT%/0.34WT%. ALL TEMPERATURES, PRESSURES, FLOW QUANTITIES, AND COMPOSITIONS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-430.
2. TEMPERATURE WILL BE GREATER THAN THIS VALUE.
3. THE UPPER STREAM TAG IDENTIFIERS REFLECT THE STREAM CONDITIONS FOR ASSAY UNIT "A", WHILE THE LOWER STREAM TAG IDENTIFIERS REFLECT THE STREAM CONDITIONS FOR ONE ASSAY UNIT OF UNITS "B" THROUGH "F". IF A GIVEN STREAM HAS ONLY ONE TAG IDENTIFIER, THEN THE STREAM CONDITION INFORMATION PRESENTED IS REPRESENTATIVE OF EACH OF THE ASSAY UNITS.
4. NORMALLY NO FLOW IN THIS LINE. VENT GASES FLOW TO THE "FEED PURIFICATION SUBSYSTEM" DURING INTERMITTENT OPERATION ONLY.
5. THE UPPER STREAM TAG IDENTIFIER REFLECTS THE COMBINED STREAM CONDITION FOR ASSAY UNIT "A" AND ASSAY UNIT "B", WHILE THE LOWER STREAM TAG IDENTIFIER REFLECTS THE COMBINED STREAM CONDITION FOR ASSAY UNITS "C" AND "D" (OR "E" AND "F") FOR MATERIAL BALANCE PURPOSES. THE FLOW RATE SHOWN IS EVENLY SPLIT BETWEEN THE FOUR ON-LINE TAILS STATIONS.

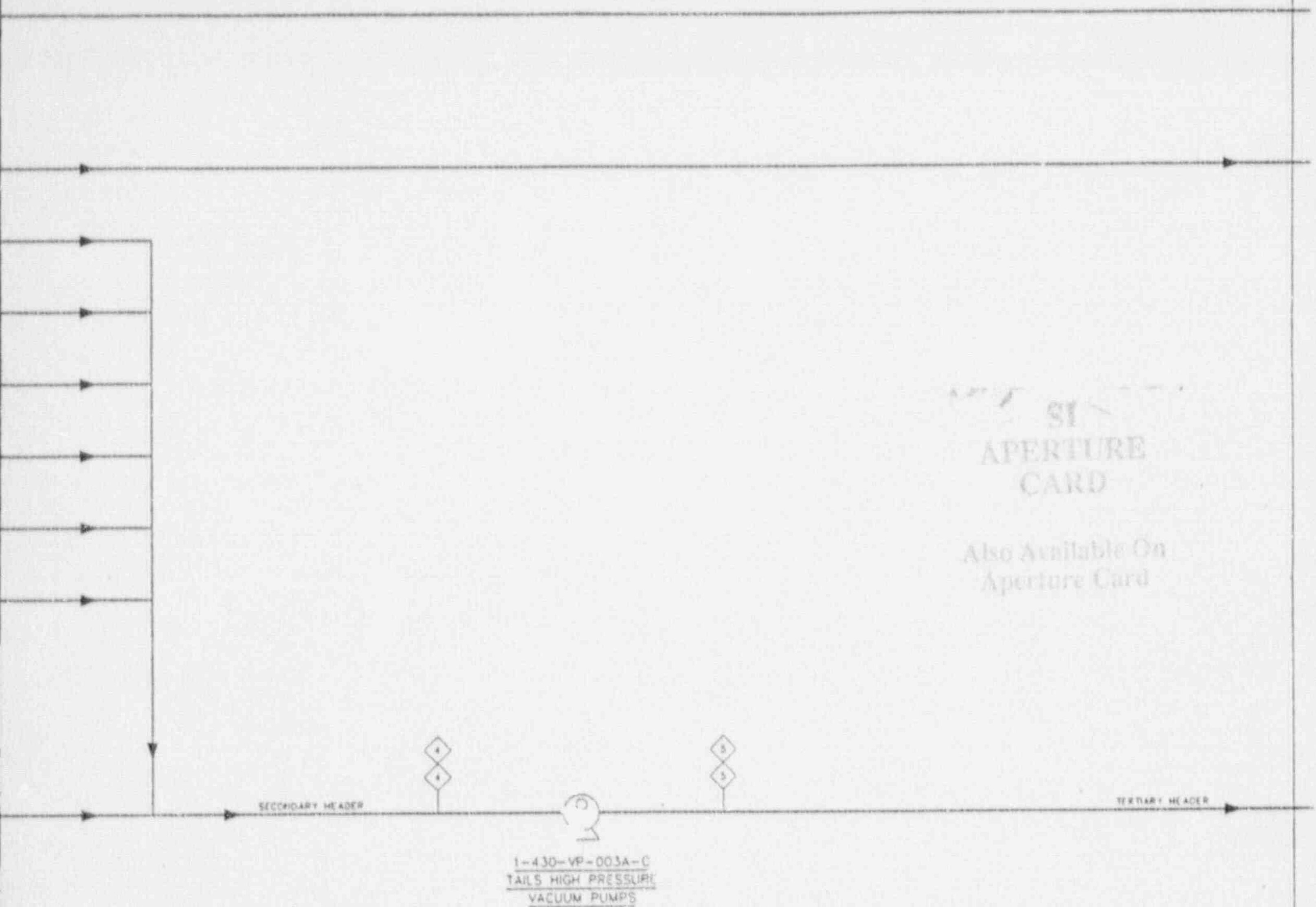
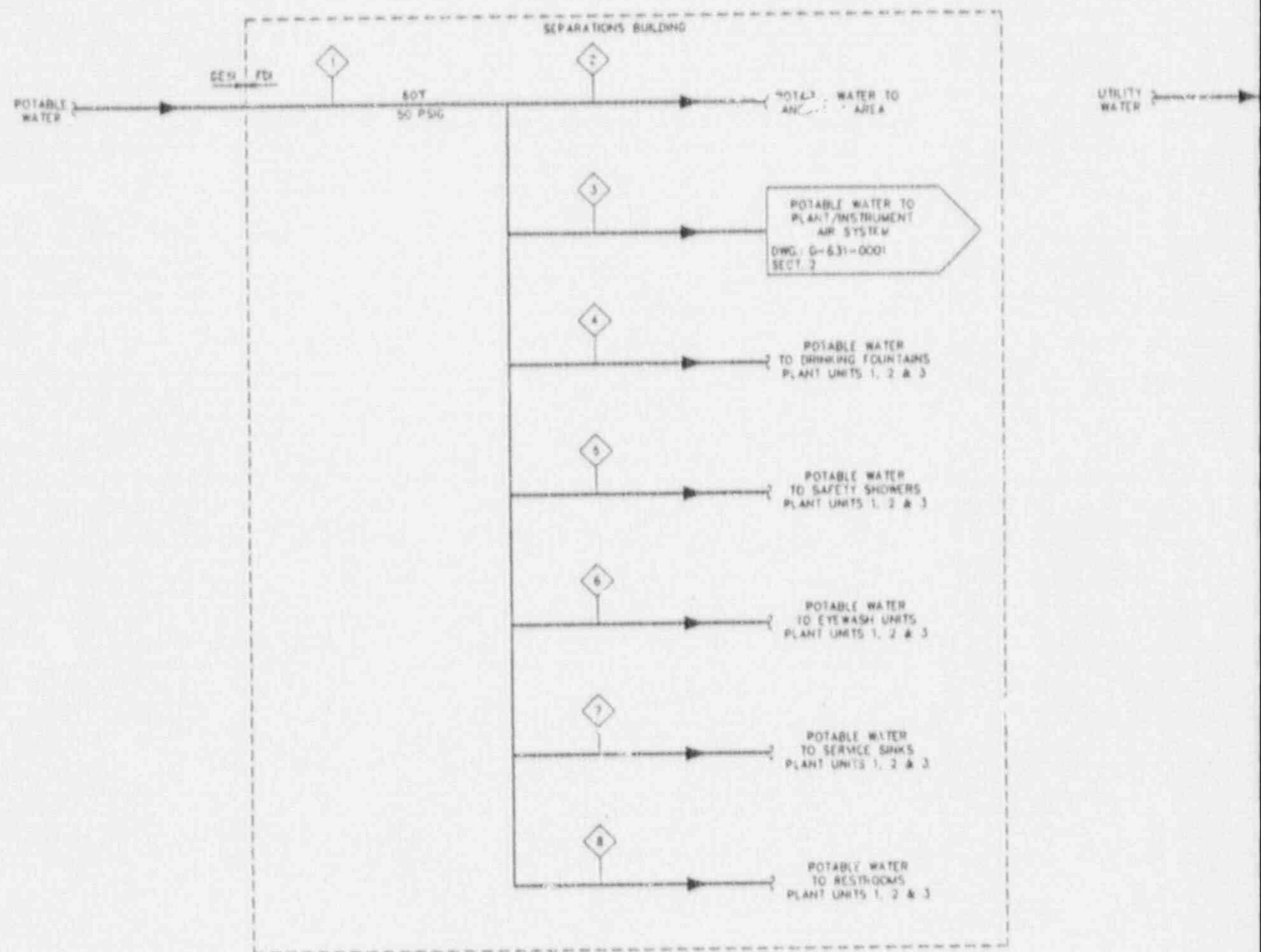


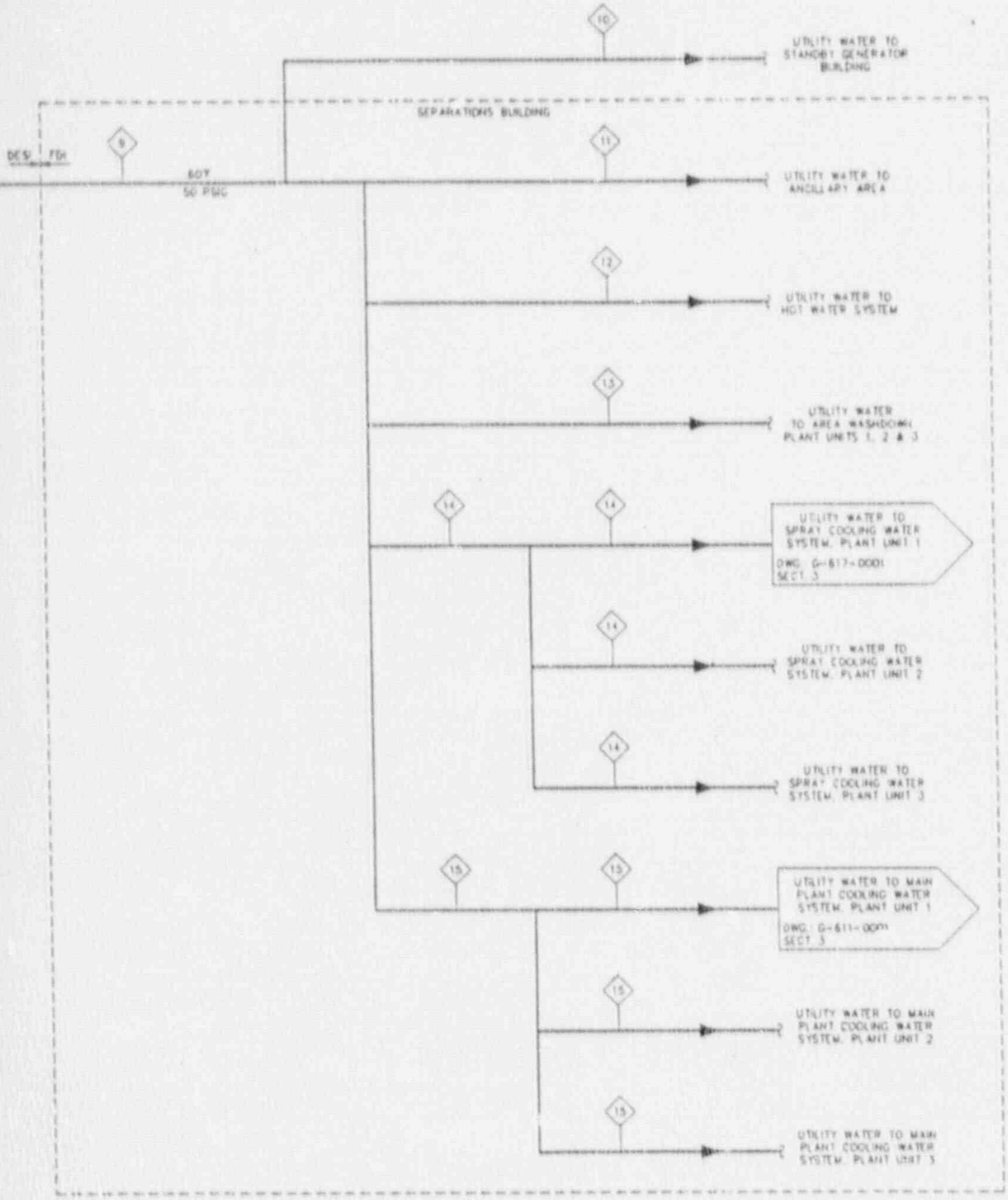
Figure 3.2-6		
DRAWING NO	REV	FRAME
G-430-0001	1	2 OF 2

5 4



STREAM NUMBER	1	2	3	4	5	6	7
DESCRIPTION	POTABLE WATER TO SEPARATIONS BUILDING	POTABLE WATER TO ANCILLARY AREA	POTABLE WATER TO AIR COMPRESSOR	POTABLE WATER TO FOUNTAINS	POTABLE WATER TO SAFETY SHOWERS	POTABLE WATER TO EYEWASH UNITS	POTABLE WATER TO SERVICE SINKS
WATER (GPM) OPERATING MAX	85	75	30	1	40	5	20
WATER (GPD)	1378	1200	0	16	0	0	40

STREAM NUMBER	8	9	10	11	12	13	14	15
DESCRIPTION	POTABLE WATER TO RESTROOMS	UTILITY WATER TO SEPARATIONS BUILDING	UTILITY WATER TO STANDBY GENERATOR BUILDING	UTILITY WATER TO ANCILLARY AREA	UTILITY WATER TO HOT WATER SYSTEM	UTILITY WATER TO AREA WASHDOWN	UTILITY WATER TO SPRAY COOLING WATER SYSTEM	UTILITY WATER TO MAIN PLANT COOLING WATER
WATER (GPM) OPERATING MAX	50	40	25	20	25	20	25	25
WATER (GPD)	120	510	0	450	0	60	0	0



NOTES:

1. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-691.

2. THIS DRAWING SHOWS ONLY THE UTILITY/POTABLE WATER DISTRIBUTION SYSTEM WITHIN THE SEPARATIONS BUILDING AND TO THE STANDBY GENERATOR BUILDING.

DWG. NO. G-691-0001 REV.0 | FRAME 1 OF 1

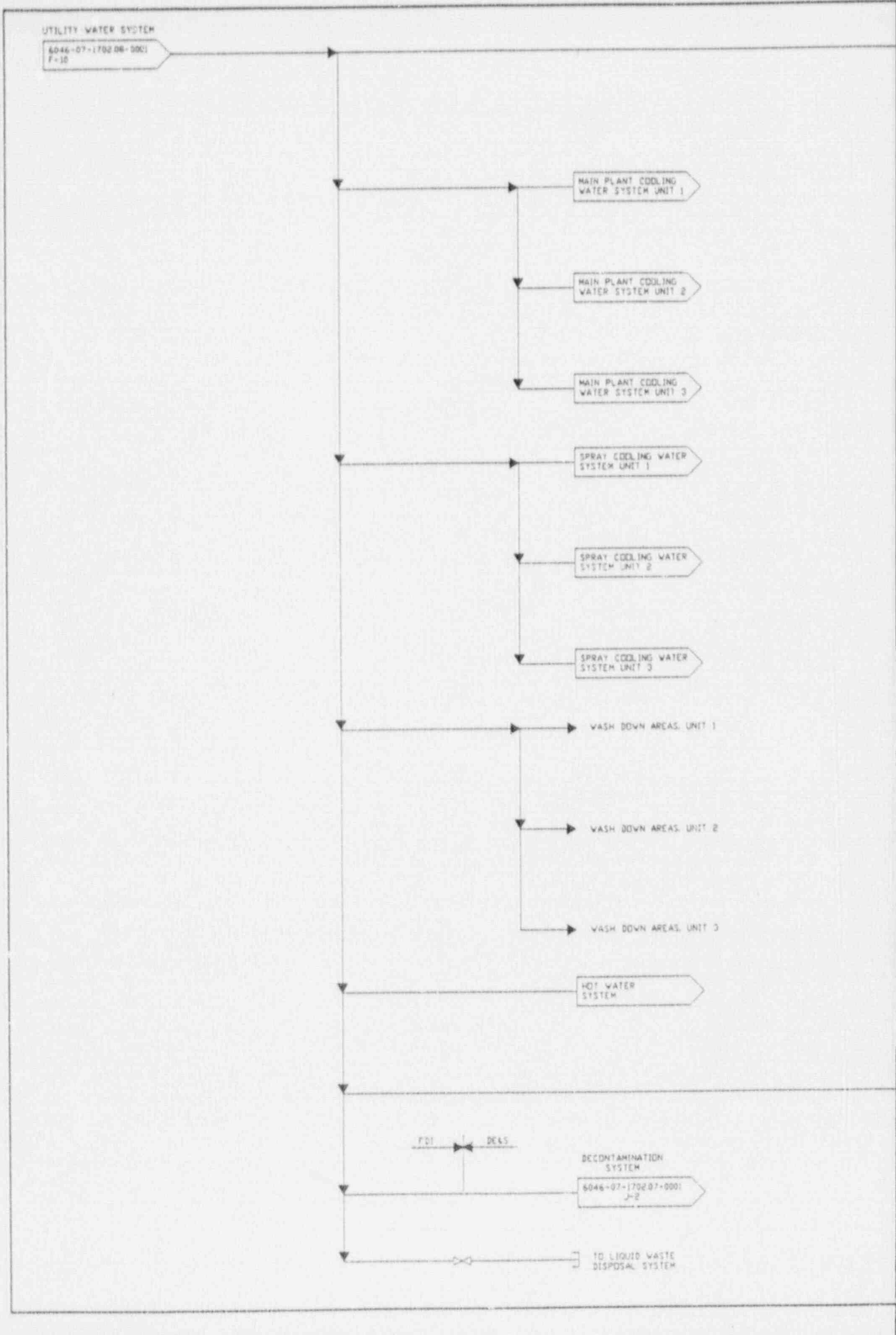
FLUOR DANIEL

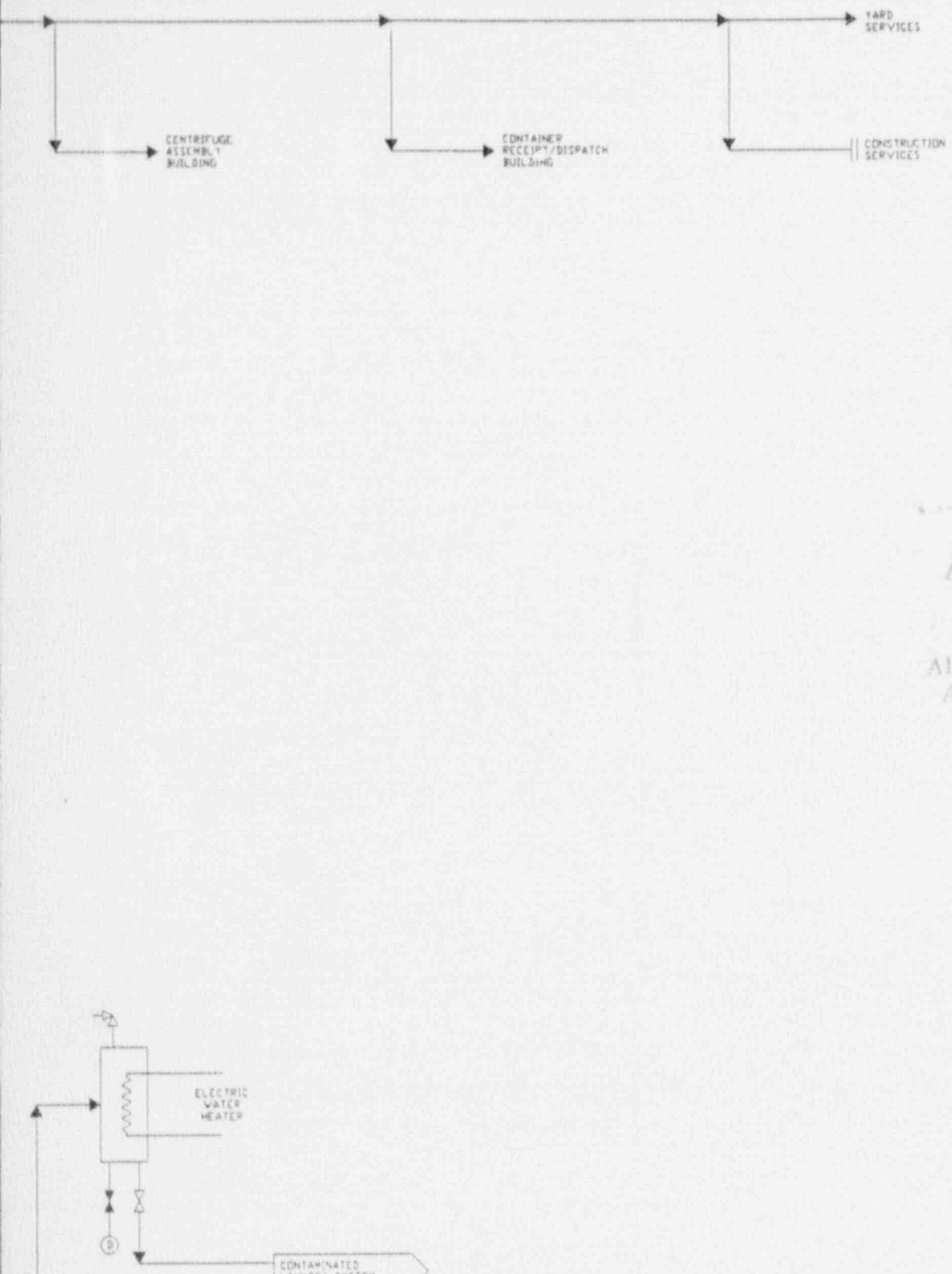
LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
UTILITY/POTABLE WATER SYSTEM

Figure 3.2-7

ACAD OF=ER327


UTILITY WATER SYSTEM
6046-07-1702.06-0001
F-10
MAIN PLANT COOLING WATER SYSTEM UNIT 1
MAIN PLANT COOLING WATER SYSTEM UNIT 2
MAIN PLANT COOLING WATER SYSTEM UNIT 3
SPRAY COOLING WATER SYSTEM UNIT 1
SPRAY COOLING WATER SYSTEM UNIT 2
SPRAY COOLING WATER SYSTEM UNIT 3
WASH DOWN AREAS, UNIT 1
WASH DOWN AREAS, UNIT 2
WASH DOWN AREAS, UNIT 3
HOT WATER SYSTEM
FDI
DE65
DECONTAMINATION SYSTEM
6046-07-1702.07-0001
J-2
TO LIQUID WASTE DISPOSAL SYSTEM



9102060114 -21

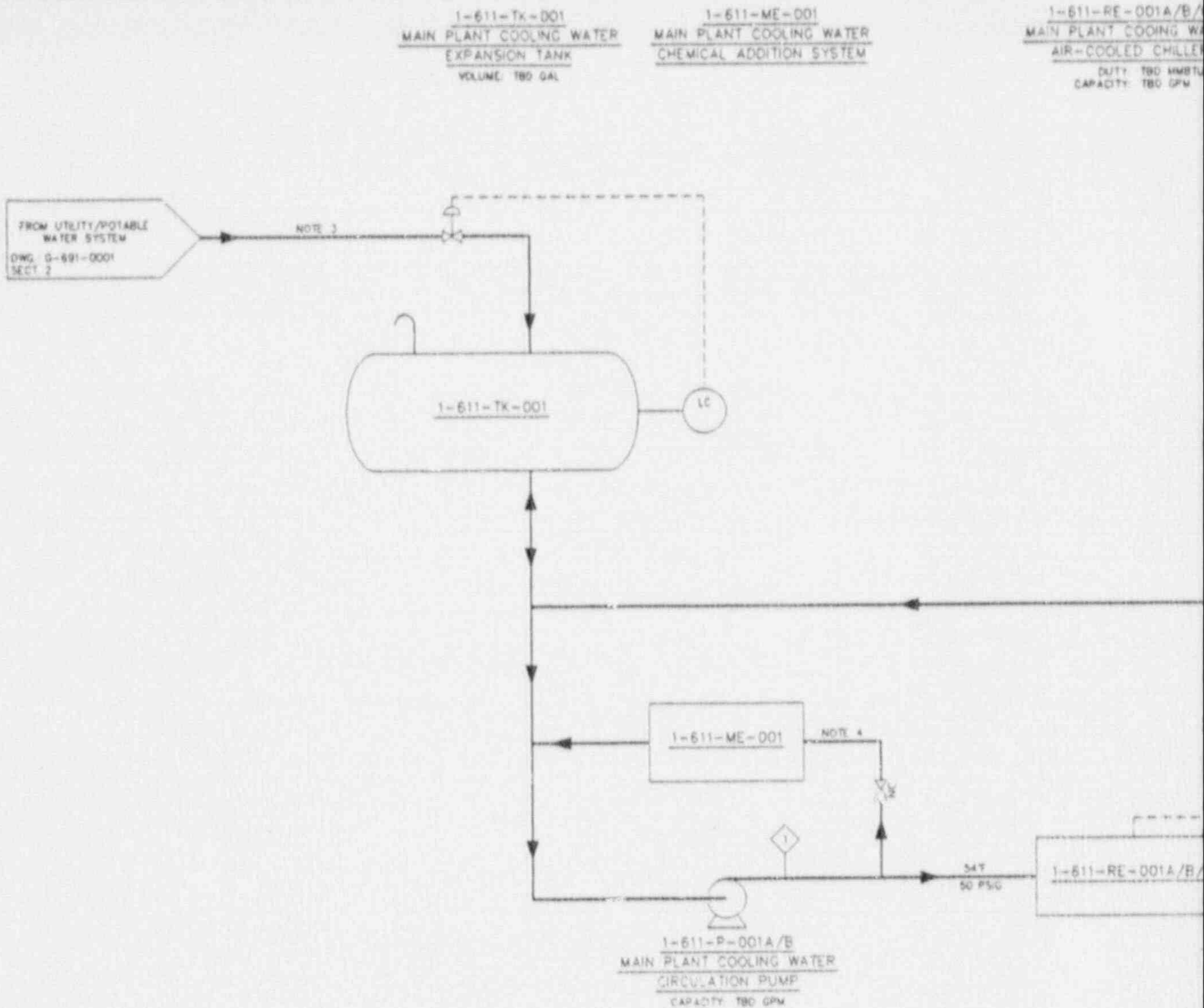
DWG. NO. 1702.08-0002 REV.0 | FRAME 1 OF 1

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

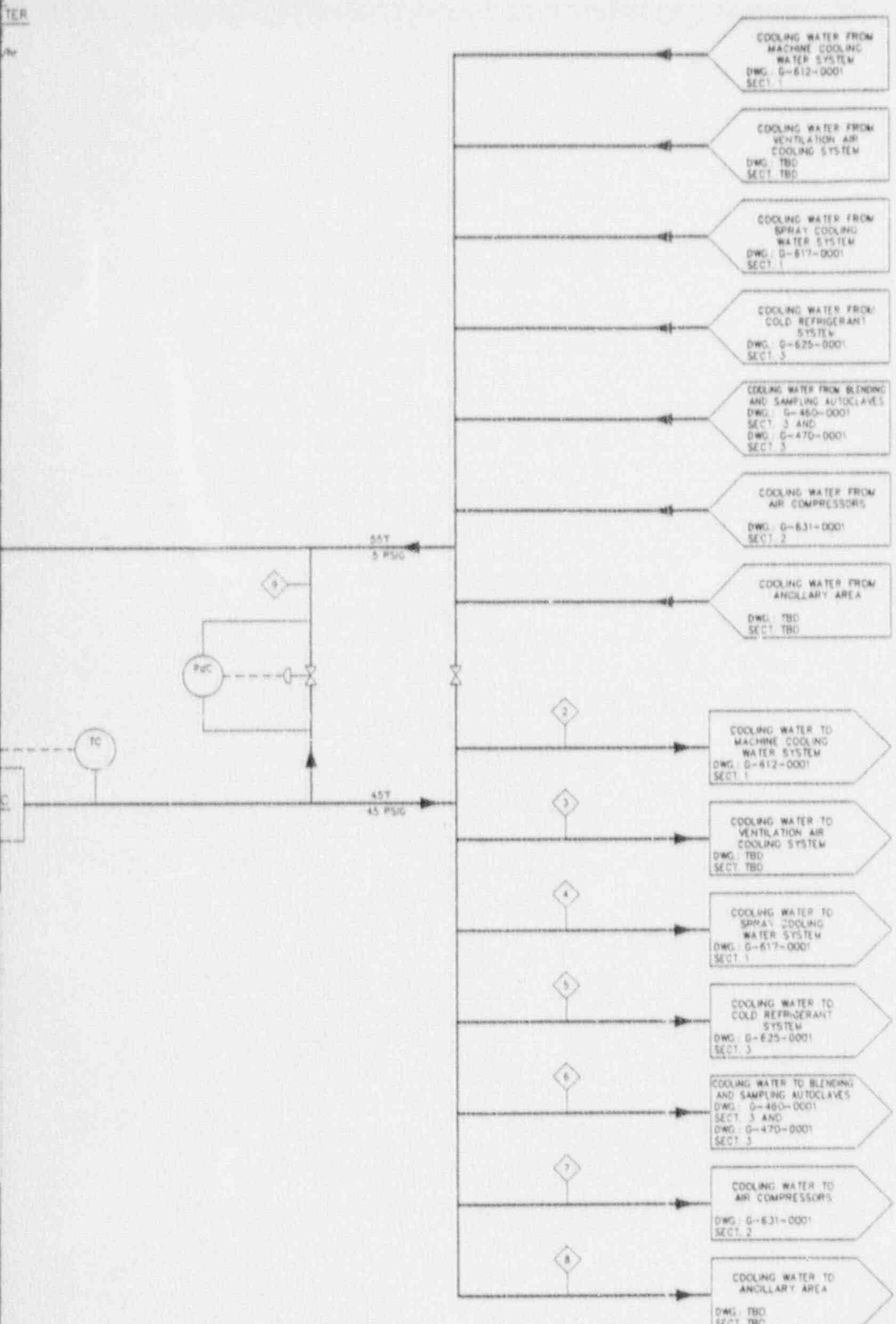
PROCESS FOW DIAGRAM
UTILITY WATER SYSTEM

Figure 3.2-8

ACAD DF+ER329



STREAM NUMBER	1	2	3	4	5	6	7	8	9
STREAM DESCRIPTION	MAIN PLANT COOLING WATER (MPCW)	MPCW TO MACHINE COOLING WATER SYSTEM	MPCW TO VENTILATION AIR COOLING	MPCW TO SPRAY COOLING WATER SYSTEM	MPCW TO COLD REFRIGERANT SYSTEM	MPCW TO AUTOCLAVES	MPCW TO INSTRUMENT AIR COMPRESSORS	MPCW TO ANCILLARY BUILDING	SYSTEM BYPASS
WATER (GPM) MAXIMUM OPERATING	TBD	818	TBD	62	50	34	29	89	TBD



NOTES:

1. THE MAIN PLANT COOLING WATER (MPCW) SYSTEM FOR PLANT UNIT 1 IS SHOWN HERE. THE MPCW SYSTEMS FOR PLANT UNITS 2 AND 3 ARE IDENTICAL TO THE ONE SHOWN HERE EXCEPT THAT THEY DO NOT PROVIDE SERVICE TO THE AIR COMPRESSORS, THE ANCILLARY USERS AND TO THE HVAC SYSTEM OF THE ANCILLARY AREA.
2. THE MAXIMUM COOLING DUTY IS ACHIEVED BY OPERATING TWO OF THE THREE CHILLERS.
3. MAXIMUM OPERATING RATE OF FILL AND MAKEUP LINE IS 25 GPM.
4. MAXIMUM OPERATING RATE IS 5 GPM. NORMALLY NO FLOW.
5. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-611.

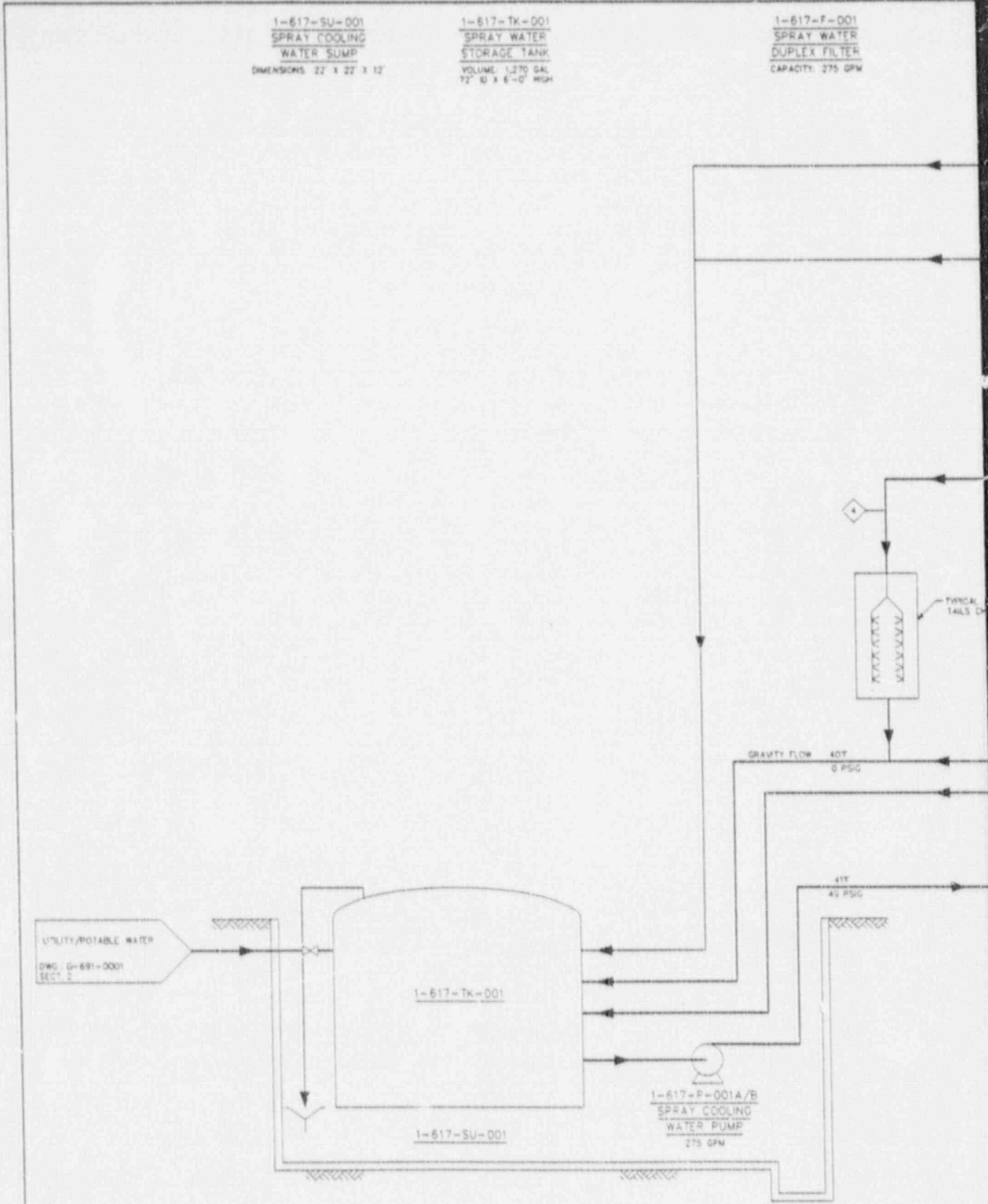
DWG. NO. G-611-0001 REV.0	FRAME 1 OF 1

FLUOR DANIEL
ADVANCED TECHNOLOGY DIVISION

LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

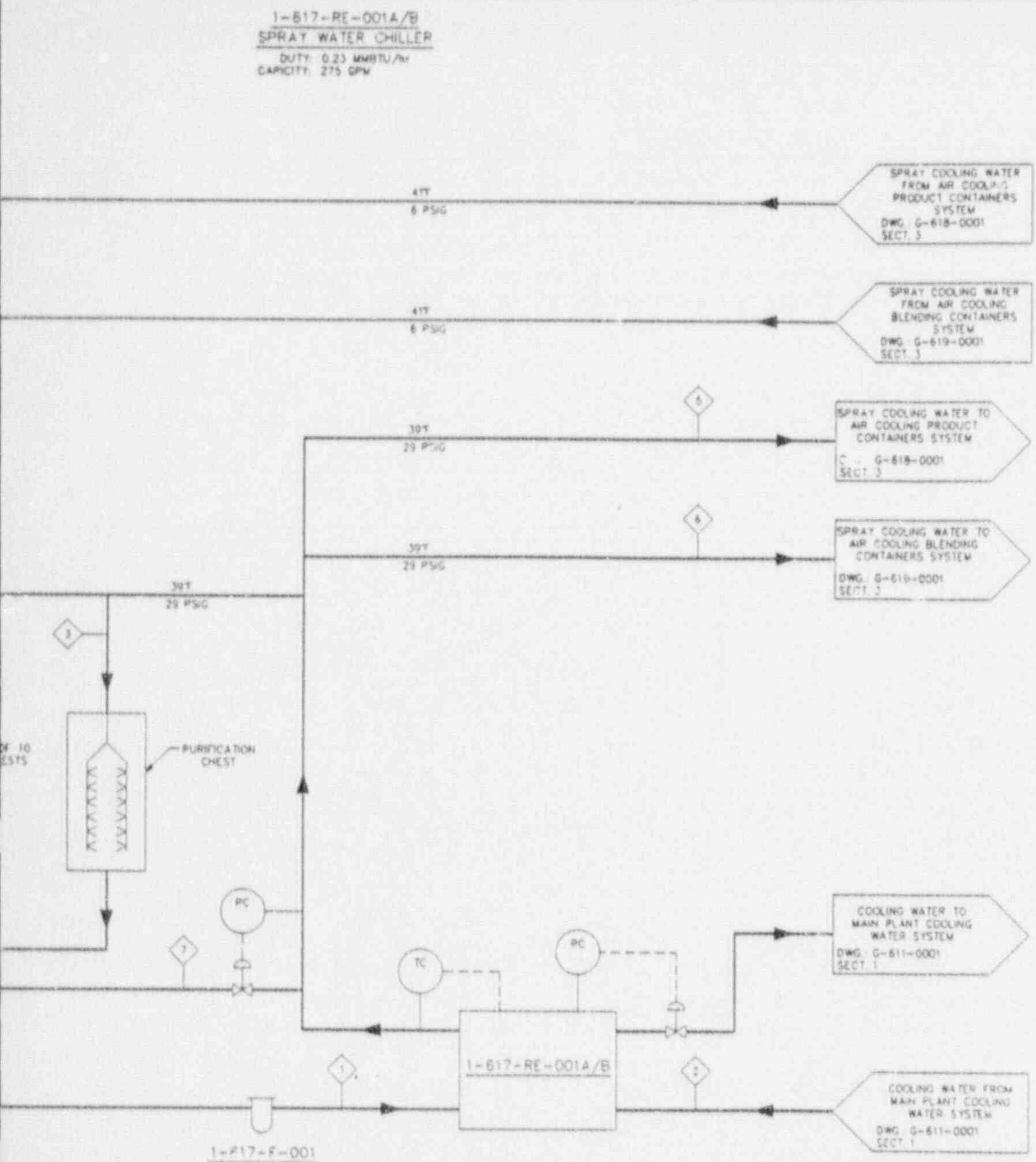
PROCESS FLOW DIAGRAM
MAIN PLANT
COOLING WATER SYSTEM
Figure 3.2-9

ACAD DF=ER329



STREAM NUMBER	1	2	3	4	5	6	7
STREAM DESCRIPTION	TOTAL CIRCULATING SPRAY WATER	MAIN PLANT COOLING WATER TO CHILLERS	SPRAY WATER TO PURIFICATION CHEST	SPRAY WATER TO TAILS CHEST	COOLING WATER TO PRODUCT CHESTS AIR COOLERS	COOLING WATER TO BLENDING CHESTS AIR COOLERS	COOLING WATER SPILL BACK
WATER (GPM) MAXIMUM OPERATING	275	62	12	12	88	44	TBD
WATER (GPM) NORMAL OPERATING	275	62	12	12	88	44	11

3



NOTES:

1. THE SPRAY COOLING WATER SYSTEM FOR PLANT UNIT 1 IS SHOWN HERE. THE SYSTEMS FOR PLANT UNITS 2 AND 3 ARE IDENTICAL TO THE ONE SHOWN HERE, EXCEPT THAT THEY DO NOT HAVE AN AIR COOLING BLENDING CONTAINERS SYSTEM.

2. THE SPRAY WATER RETURN TEMPERATURES REFLECT THE MAXIMUM COOLING LOADS OF THE USERS.

3. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-617.

DWG. NO. G-617-0001 REV.0	FRAME 1 OF 1

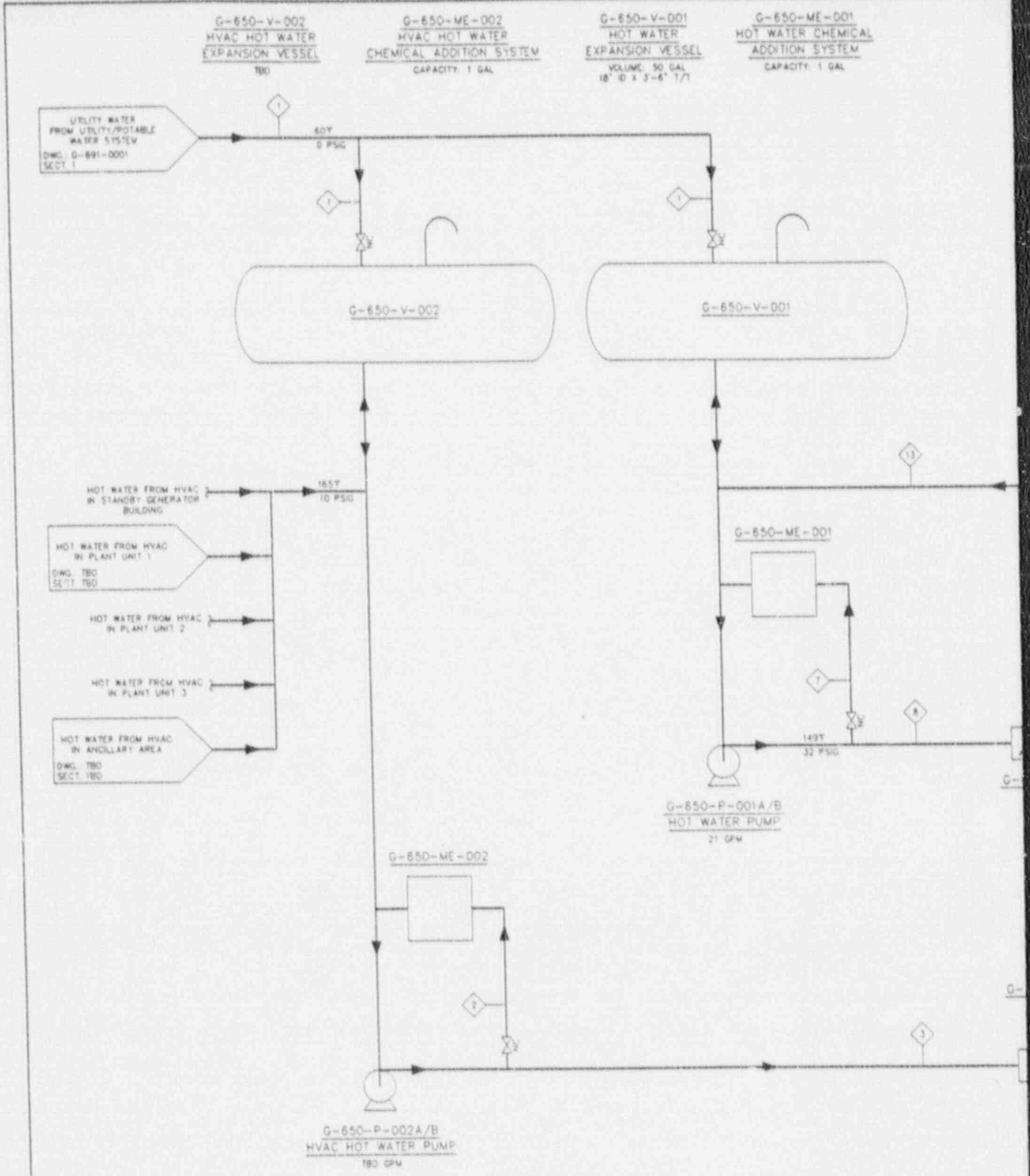
FLUOR DANIEL

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

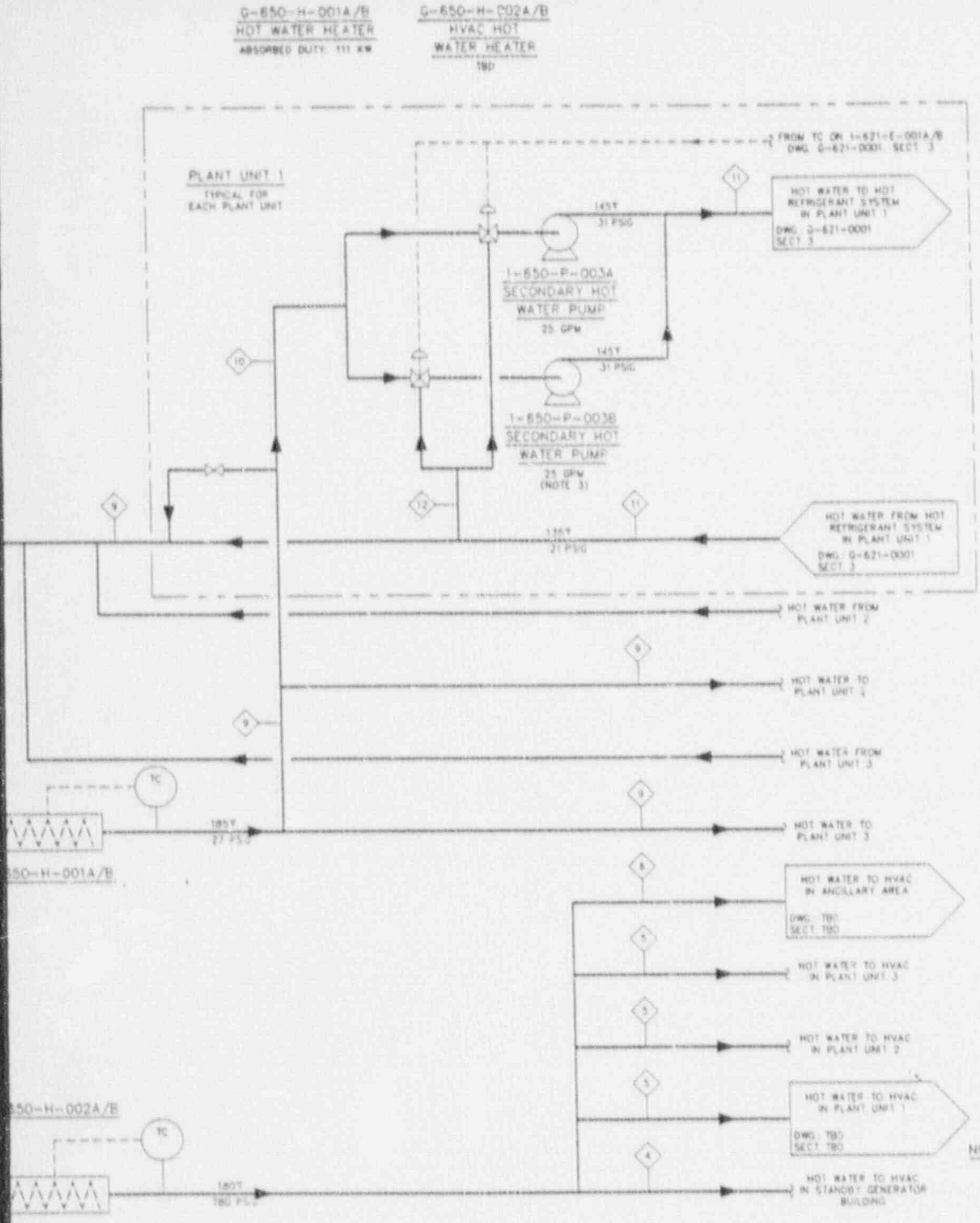
PROCESS FLOW DIAGRAM
SPRAY COOLING
WATER SYSTEM

Figure 3.2-10



STREAM NUMBER	1	2	3	4	5	6	7
DESCRIPTION	MAKEUP UTILITY WATER	HOT WATER TO CHEMICAL ADDITION SYSTEM	HOT WATER SUPPLY TO HVAC	HOT WATER TO HVAC (STANDBY GEN. BLDG.)	HOT WATER TO HVAC (PLANT UNITS 1,2,3)	HOT WATER TO HVAC (ANCILLARY AREA)	HOT WATER TO CHEMICAL ADDITION SYSTEM
WATER (GPM) NORMAL	0	0	TBD	TBD	TBD	TBD	0
WATER (GPM) OPERATING MAXIMUM	25	5	TBD	TBD	TBD	TBD	5

STREAM NUMBER	8	9	10	11	12	13
DESCRIPTION	HOT WATER SUPPLY	HOT WATER TO/FROM EACH PLANT UNIT	NET HOT WATER TO PLANT UNIT 1	HOT WATER TO/FROM HOT REFRIGERANT SYSTEM	CIRCULATING HOT WATER PLANT UNIT 1	HOT WATER RETURN
WATER (GPM) NORMAL	21	7	5	25	20	21
WATER (GPM) OPERATING MAXIMUM	21	7	5	25	20	21



NOTES

1. THIS SYSTEM SERVICES ALL THREE PLANT UNITS.
2. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-650.
3. THIS PUMP IS A SPARE (NOT NORMALLY OPERATING).

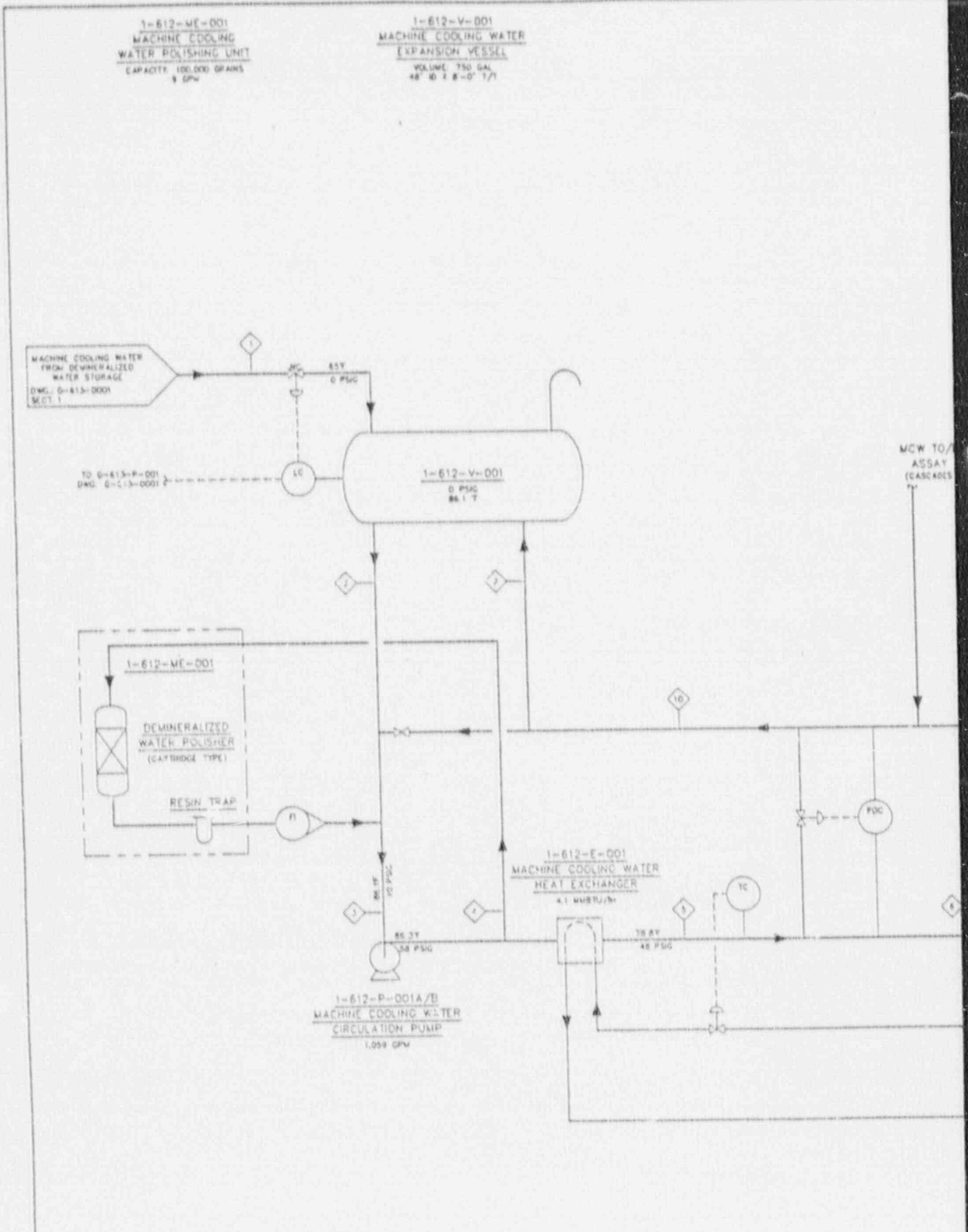
DWG. NO. G-650-0001 REV.0 | FRAME 1 OF 1

FLUOR DANIEL
ADVANCED TECHNOLOGY DIVISION

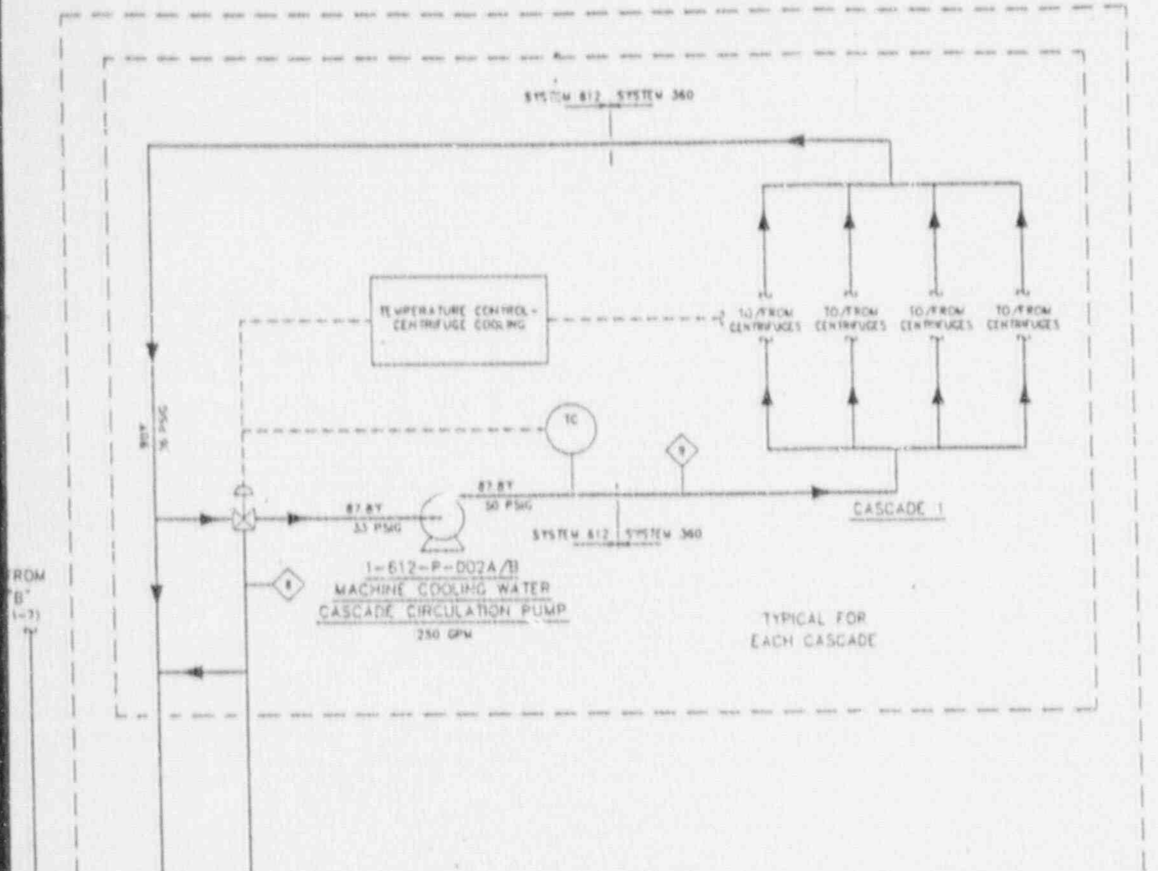
LOUISIANA ENERGY
CLAIBORNE ENRICHMENT CENTER
PROCESS FLOW DIAGRAM
HOT WATER SYSTEM

Figure 3.2-11

ACAD DF4ER3211



STREAM NUMBER	1	2	3	4	5	6	7	8	9	10
STREAM DESCRIPTION	MACHINE COOLING WATER FROM STORAGE	MCW TO/ FROM EXPANSION VESSEL	MCW TO CIRCULATION PUMP	SLIPSTREAM TO MCW POLISHING UNIT	MCW SUPPLY TO CASCADE COOLING	MCW TO EACH ASSAY	MCW TO EACH CASCADE	NET MCW TO CASCADE 1	MCW TO CASCADE	MCW RETURN FROM CASCADE COOLING
WATER (GPM)	20	158	1,059	9	1,050	525	75	49	250	1,050



NOTES:

1. THIS DRAWING SHOWS THE MACHINE COOLING WATER SYSTEM FOR PLANT UNIT 1. IDENTICAL SYSTEMS ARE PROVIDED FOR PLANT UNITS 2 AND 3. EACH PLANT UNIT COMPRISES TWO ASSAYS, "A" AND "B", EACH WITH CASCADES NUMBERED 1 THROUGH 7.

2. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-612.

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DWG NO G-612-0001	REV 0	FRAME 1 OF 1

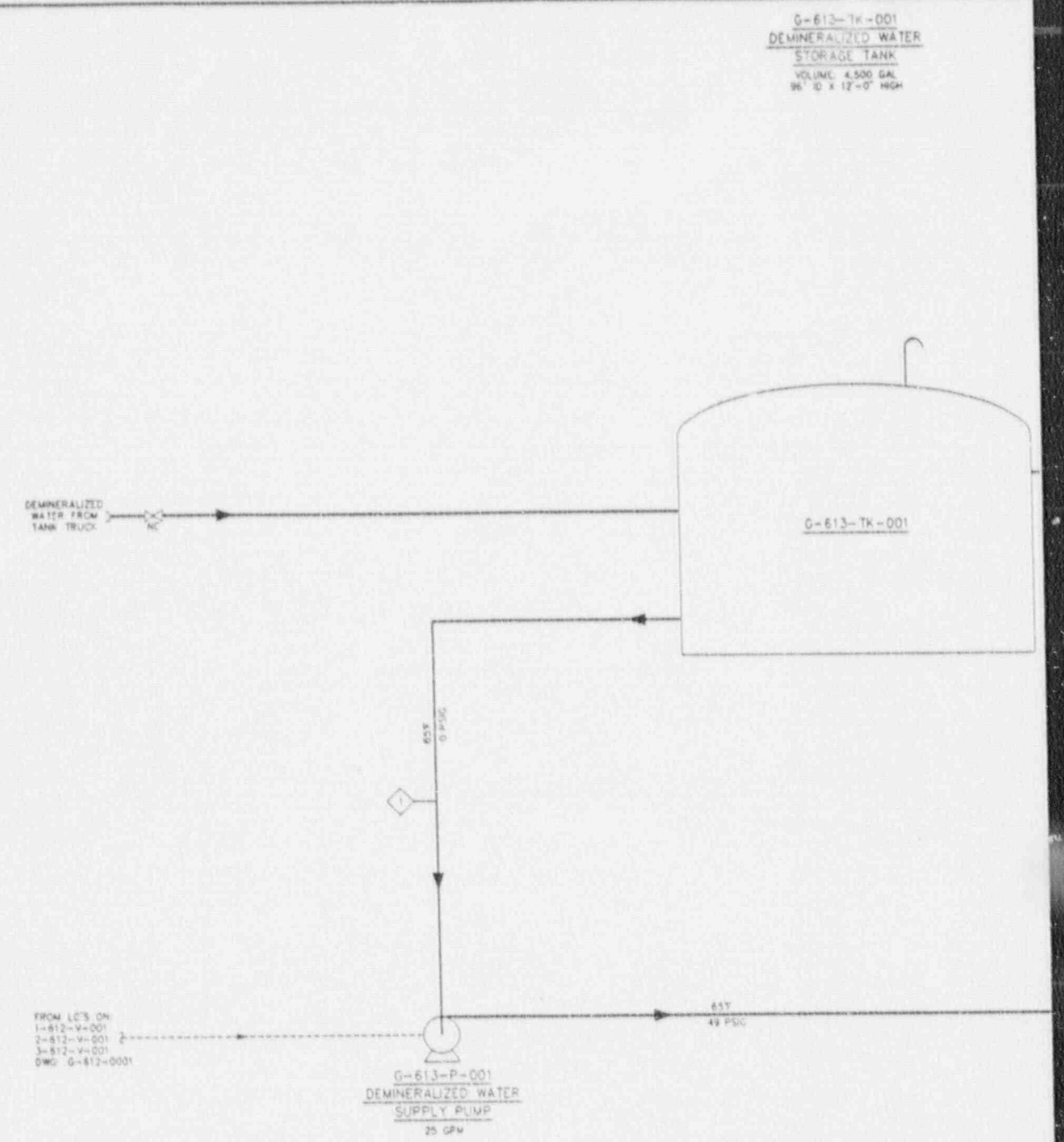
FLUOR DANIEL

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

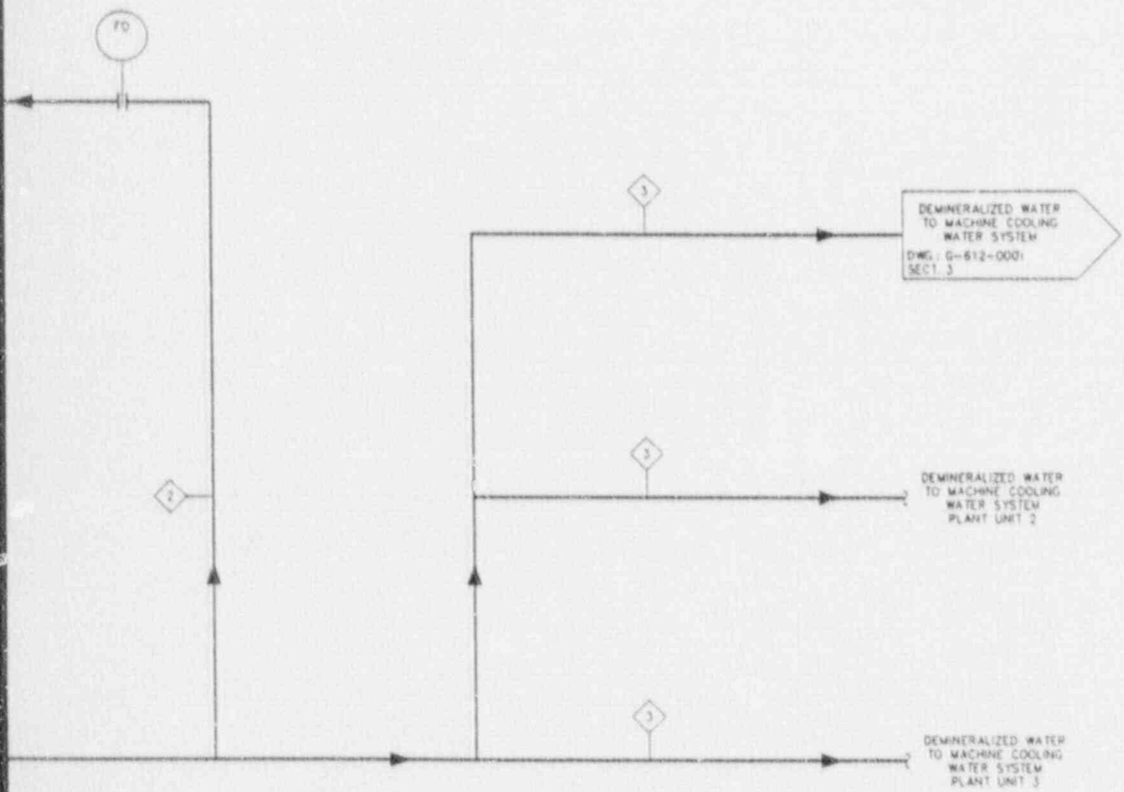
PROCESS FLOW DIAGRAM
MACHINE COOLING WATER SYSTEM

Figure 3.2-12

9102060114 -25



STREAM NUMBER	1	2	3
STREAM DESCRIPTION	DEMIN WATER FROM STORAGE	MINIMUM FLOW BYPASS	DEMIN WATER TO SYSTEM 612
WATER (GPM) OPERATING	25	5	20
WATER (GPM) NORMAL	NNF	NNF	NNF

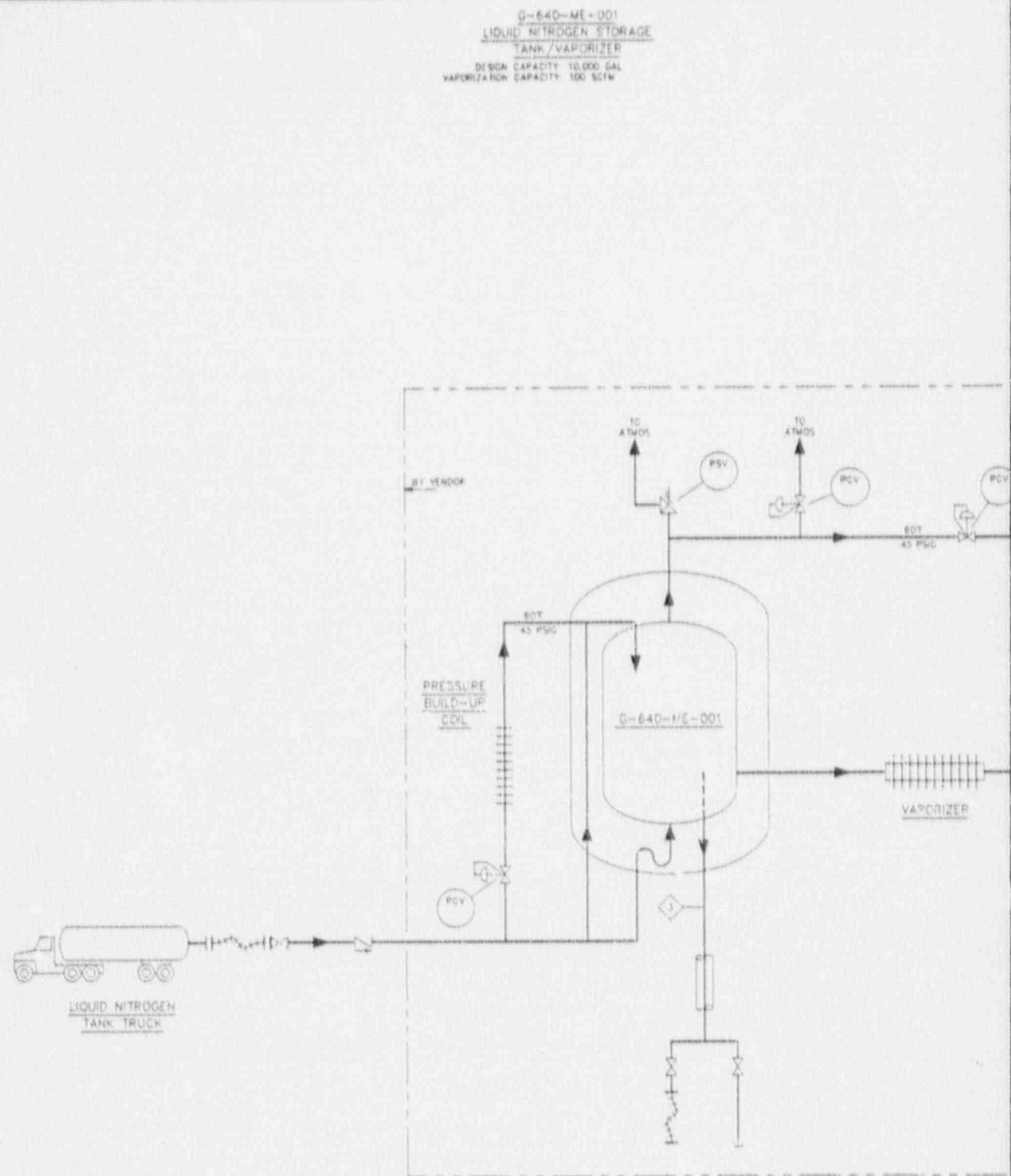


NOTES:

1. ONE DEMINERALIZED WATER STORAGE SYSTEM IS PROVIDED IN THE L.E.S. PLANT. THIS SYSTEM SUPPLIES MAKEUP WATER TO ALL THREE PLANT UNITS.
2. THIS SYSTEM OPERATES INTERMITTENTLY. FLOW RATES ARE SHOWN AS "OPERATING" WHEN THE SYSTEM IS OPERATING. FLOW RATES ARE SHOWN AS "NORMAL" WHEN THE SYSTEM IS NOT OPERATING.
3. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-613.

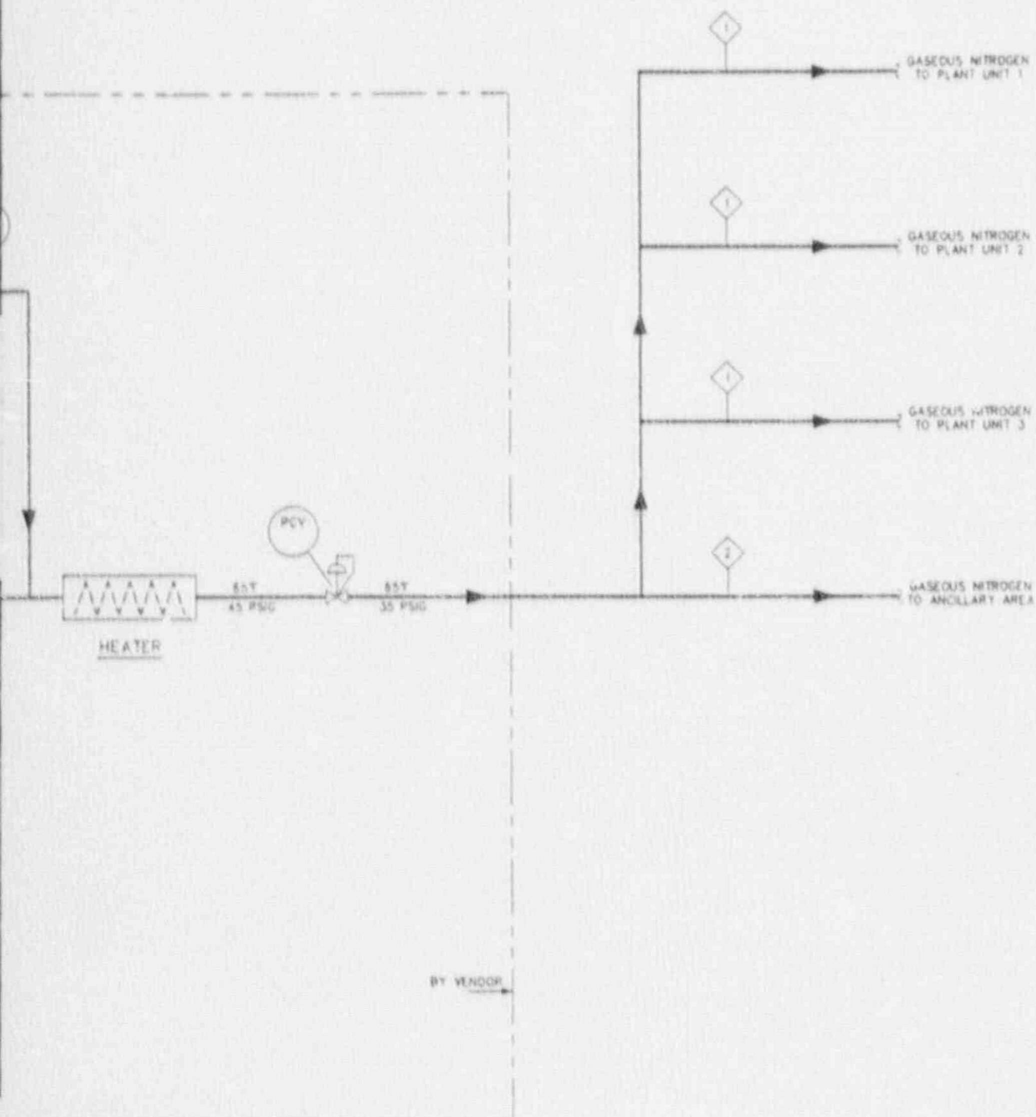
DWG. NO. G-613-0001 REV.0	FRAME 1 OF 1
FLUOR DANIEL	LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER PROCESS FLOW DIAGRAM DEMINERALIZED WATER STORAGE Figure 3.2-13

2 1



STREAM NUMBER	1	2	3
DESCRIPTION	GASEOUS NITROGEN TO PLANT UNITS	GASEOUS NITROGEN TO ANCILLARY AREA	LIQUID NITROGEN
GASEOUS N_2 (SCFM) OPERATING MAX	25	25	
LIQUID N_2 (GPM) OPERATING MAX			5

3



NOTES:

1. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-640.

2. THE LIQUID NITROGEN STORAGE TANK/VAPORIZER PACKAGE UNIT IS LOCATED ON THE L.E.S. PLANT SITE ADJACENT TO THE SEPARATIONS BUILDING AND IS LEASED FROM THE LIQUID NITROGEN SUPPLIER.

DWG. NO. G-640-0001 REV.0	FRAME 1 OF 1

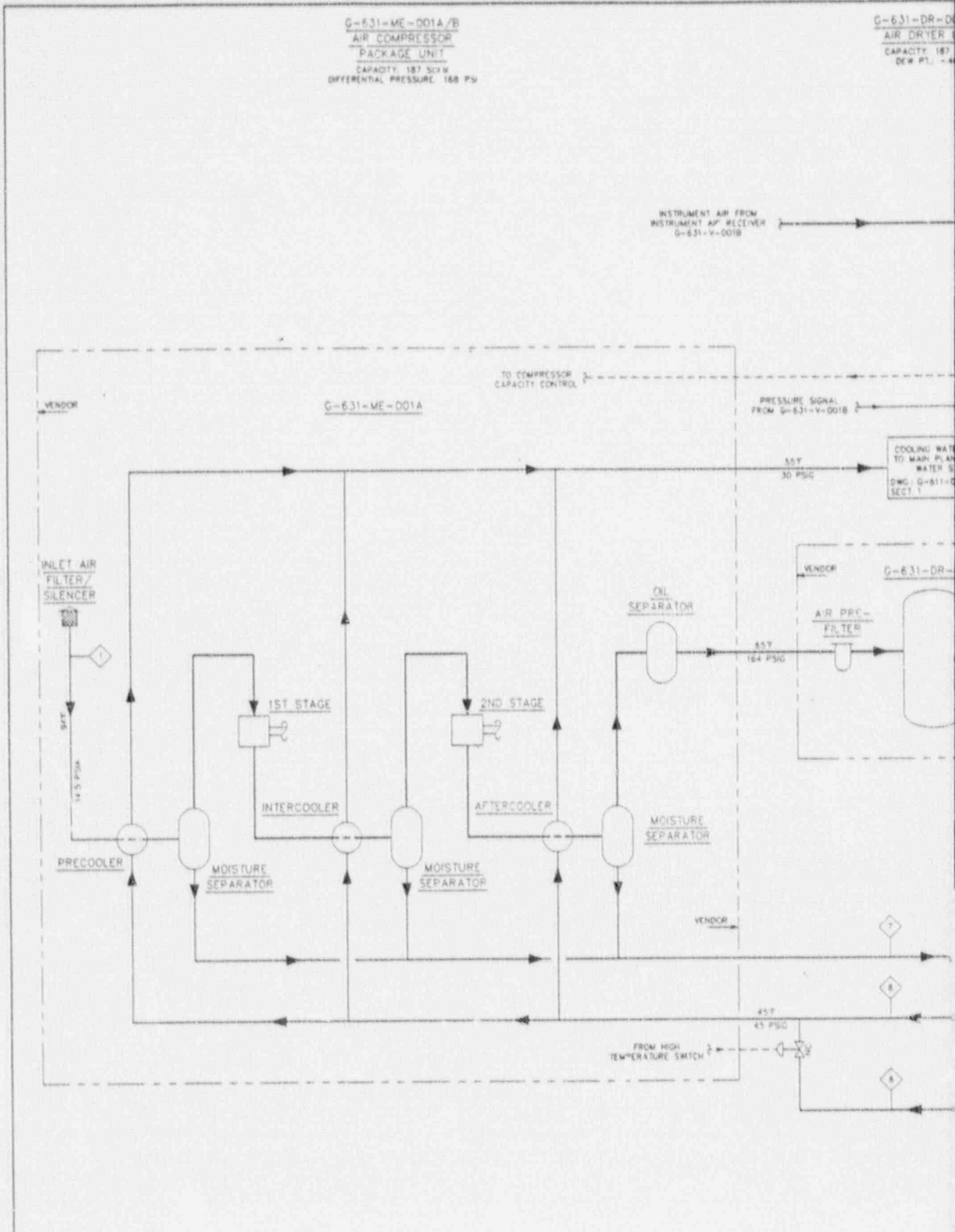
FLUOR DANIEL

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
NOTROGEN SYSTEM

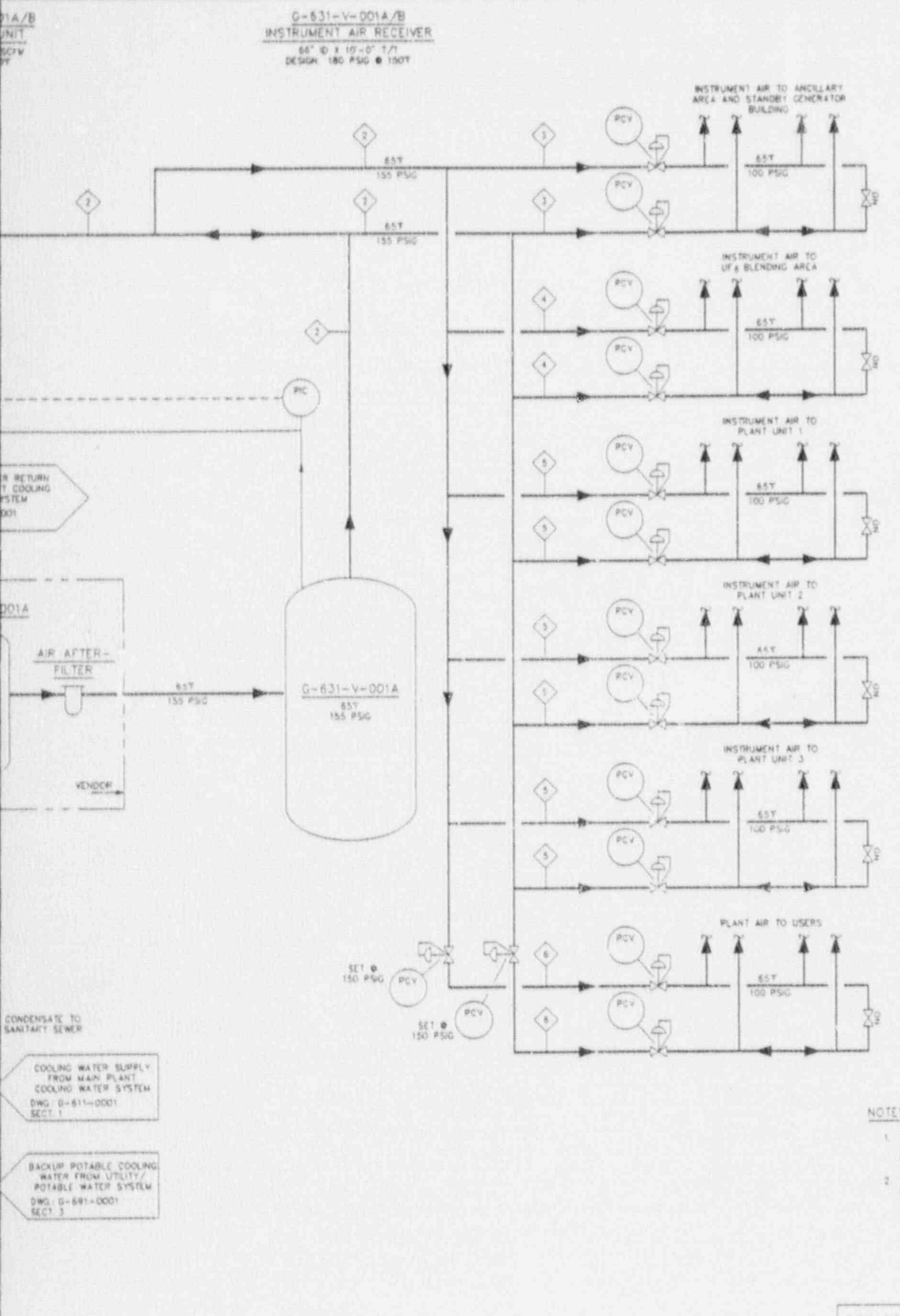
Figure 3.2-14

ACAD DF= ER3214



STREAM NUMBER	1	2	3	4	5	6	7	8
DESCRIPTION	COMPRESSOR INTAKE AIR	INSTRUMENT AIR	INSTRUMENT AIR TO ANCILLARY AREA	INSTRUMENT AIR TO UF_6 BLENDING AREA	INSTRUMENT AIR TO PLANT UNITS 1, 2, AND 3	PLANT AIR TO USERS	MOISTURE SEPARATOR CONDENSATE	MPCW SUPPLY
AIR (SCFM) OPERATING MAX	187	187	(TBD)	(TBD)	(TBD)	(TBD)		
WATER (GPM) NORMAL								29
WATER (GPD) OPERATING MAX							40	

3



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NOTES:

1. TWO 100% CAPACITY AIR COMPRESSOR PACKAGE UNITS AND AIR DRYER UNITS PROVIDE ALL PLANT AND INSTRUMENT AIR FOR THE THREE PLANT UNITS.
2. ALL TEMPERATURES, PRESSURES, AND FLOWS ARE FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-631.

DWG NO. G-631-0001 REV.0 | FRAME 1 OF 1

FLUOR DANIEL

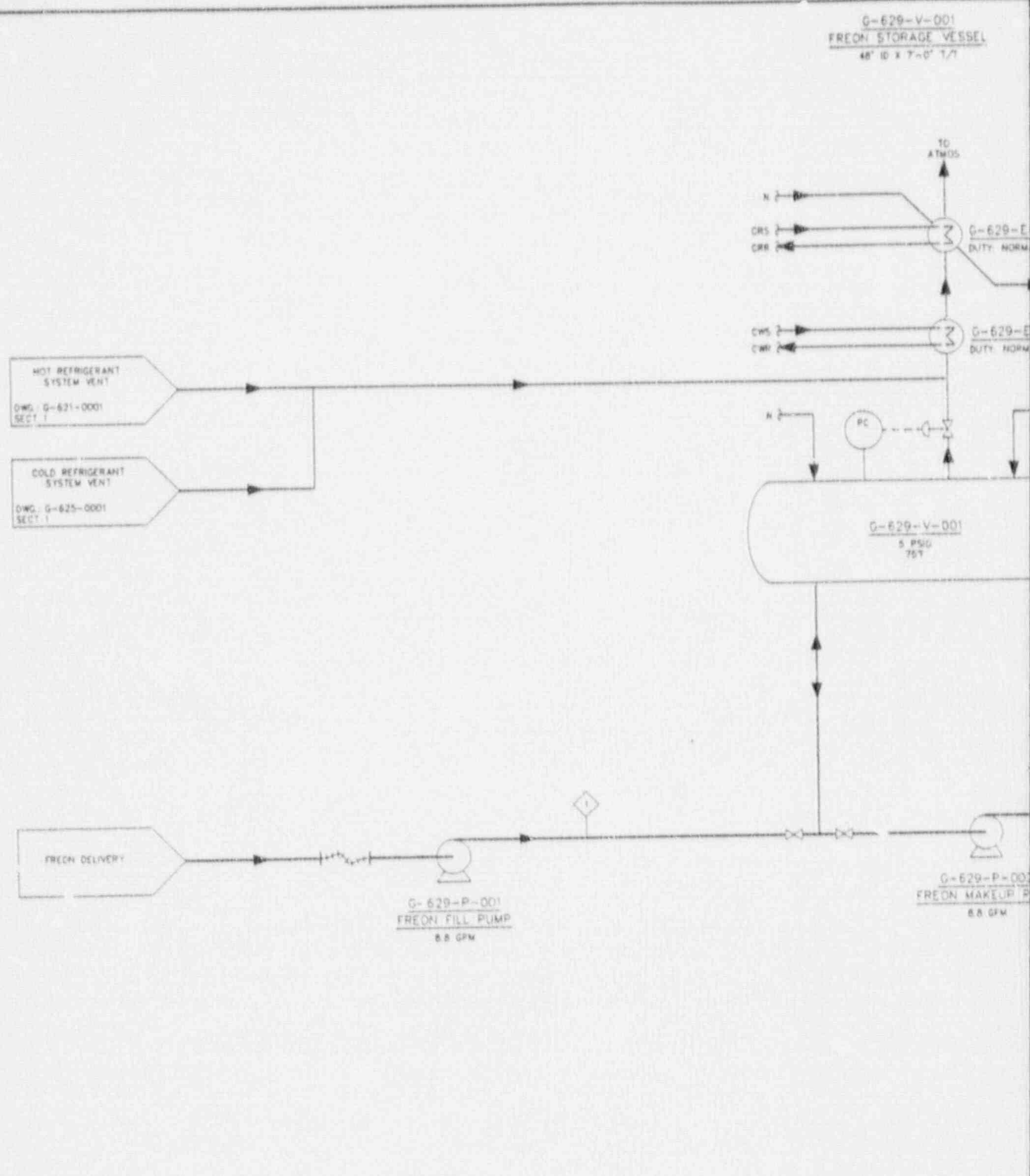
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
PLANT/INSTRUMENT
AIR SYSTEM

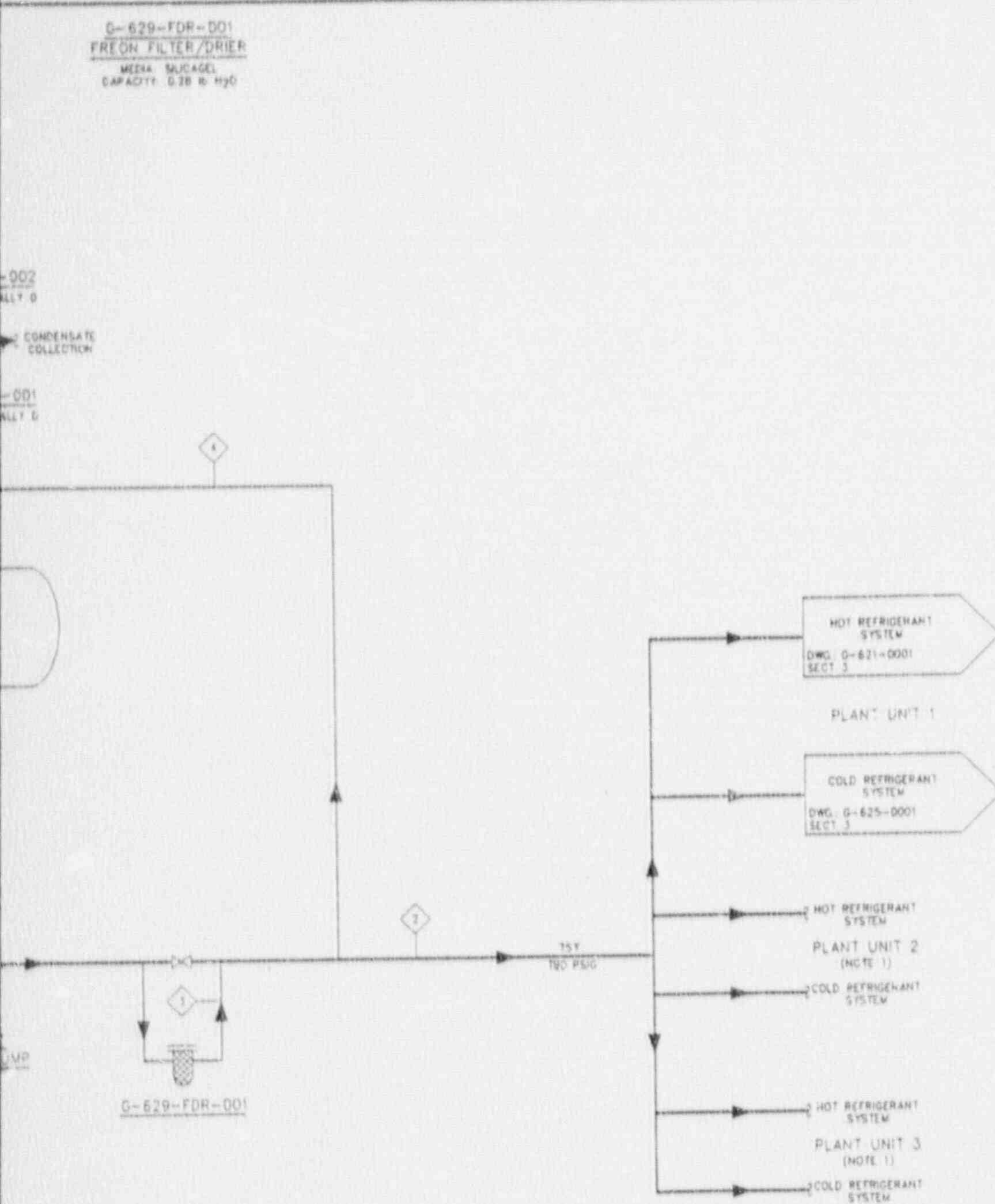
Figure 3.2-15

9102060114-28

ACAD DF=ER3215



STREAM NUMBER	1	2	3	4
DESCRIPTION	STORAGE FILL	FREON FILL/MAKEUP	FILTER/DRIER FLOW	FILTER/DRIER RECIRCULATION
FREON R11, GPM				
STORAGE FILL	8.8	NORMALLY 0	NORMALLY 0	NORMALLY 0
SYSTEM MAKEUP	NORMALLY 0	8.8	NORMALLY 0	NORMALLY 0



NOTES

1. HOT AND COLD REFRIGERANT SYSTEMS FOR PLANT UNITS 2 AND 3 ARE IDENTICAL TO THOSE FOR PLANT UNIT 1 EXCEPT FOR BLENDING DESUBLIMER. SEE DWGS. G-621-0001 AND G-625-0001.

2. ALL TEMPERATURES, PRESSURES, FLOWS AND COMPOSITIONS FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE "SYSTEM DESIGN BASIS", SDB 629.

DWG. NO. G-629-0001 REV.0	FRAME 1 OF 1

FLUOR DANIEL
ADVANCED TECHNOLOGY DIVISION

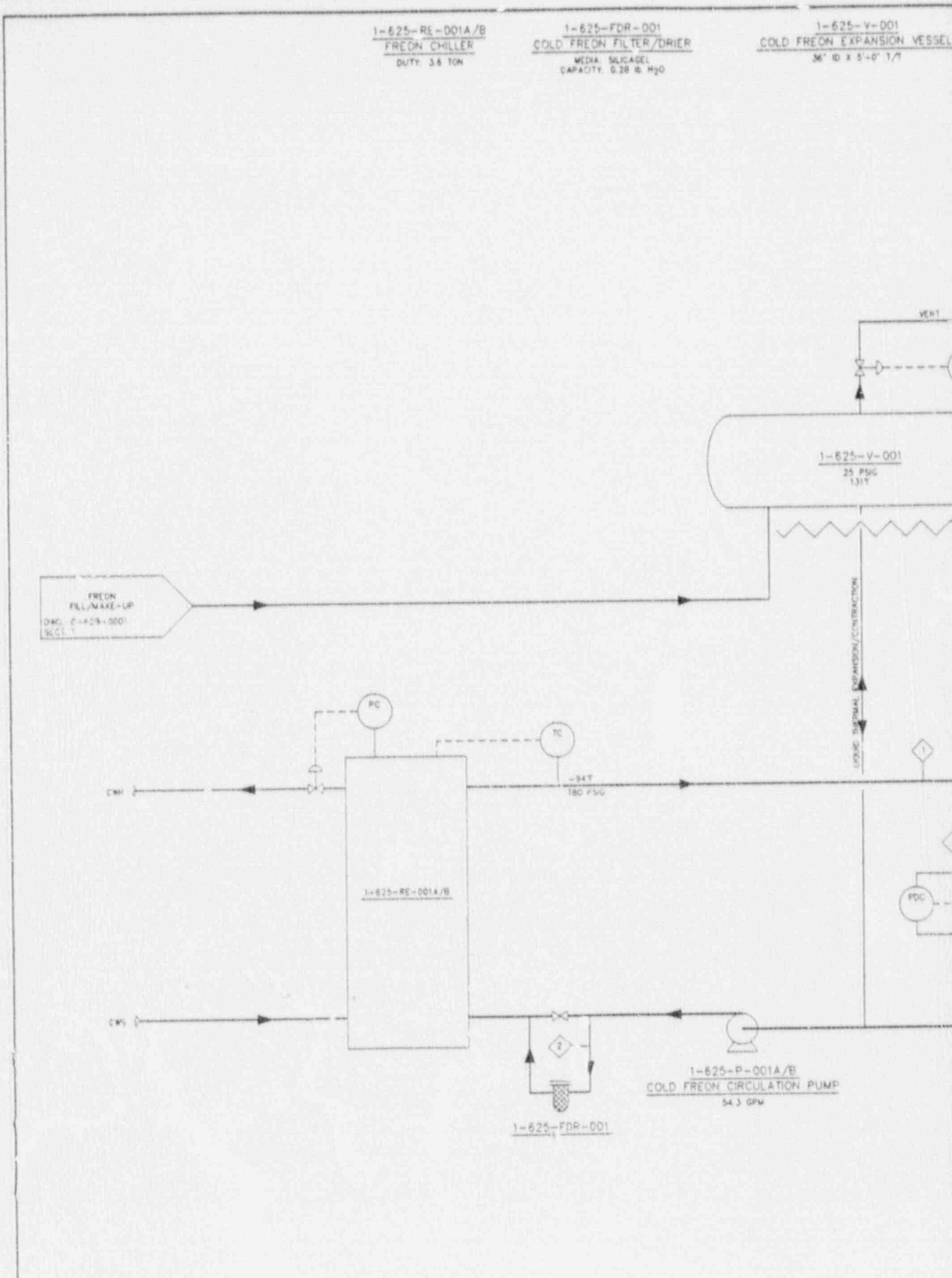
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
REFRIGERANT SUPPLY SYSTEM

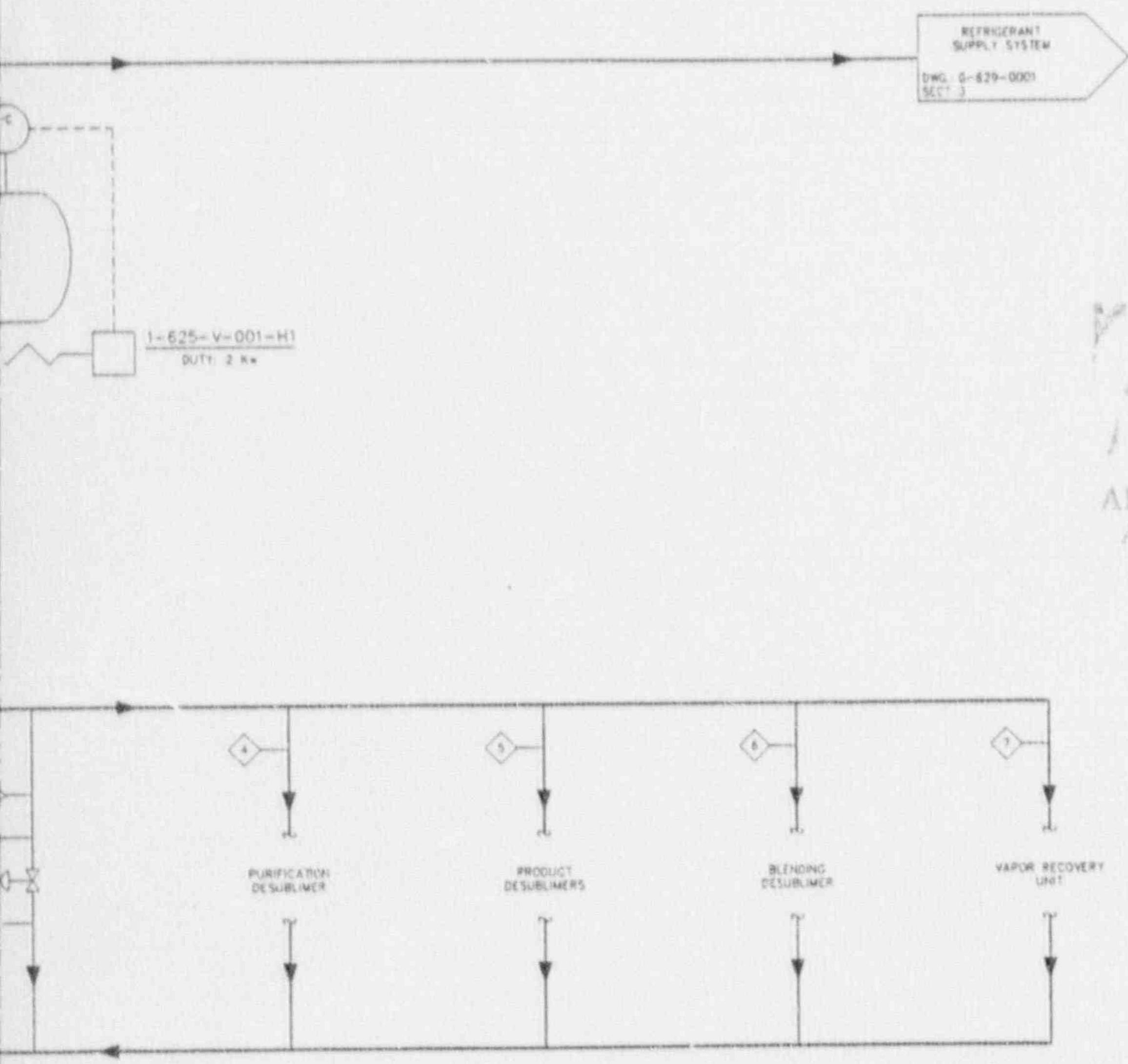
Figure 3.2-16

ACAD DF=ER3216

2 1



STREAM NUMBER	1	2	3	4	5	6	7
DESCRIPTION	CIRCULATING REFRIGERANT	FILTER/DRIER FLOW	BYPASS FLOW	COLD FREON	COLD FREON	COLD FREON	COLD FREON
FREON X11, GPM	54.3	NORMALLY 0	18.1	17.6	13.2	4.4	1.0



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NOTES:

1. SYSTEM SHOWN IS FOR PLANT UNIT 1.
2. SYSTEMS FOR PLANT UNITS 2 AND 3 ARE IDENTICAL EXCEPT FOR BLENDING DESUBLIMER AND VAPOR RECOVERY UNIT WHICH EXIST ONLY IN PLANT UNIT 1.
3. ALL TEMPERATURES, PRESSURES, FLOWS AND COMPOSITIONS FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE "SYSTEM DESIGN BASIS", SDB 625.

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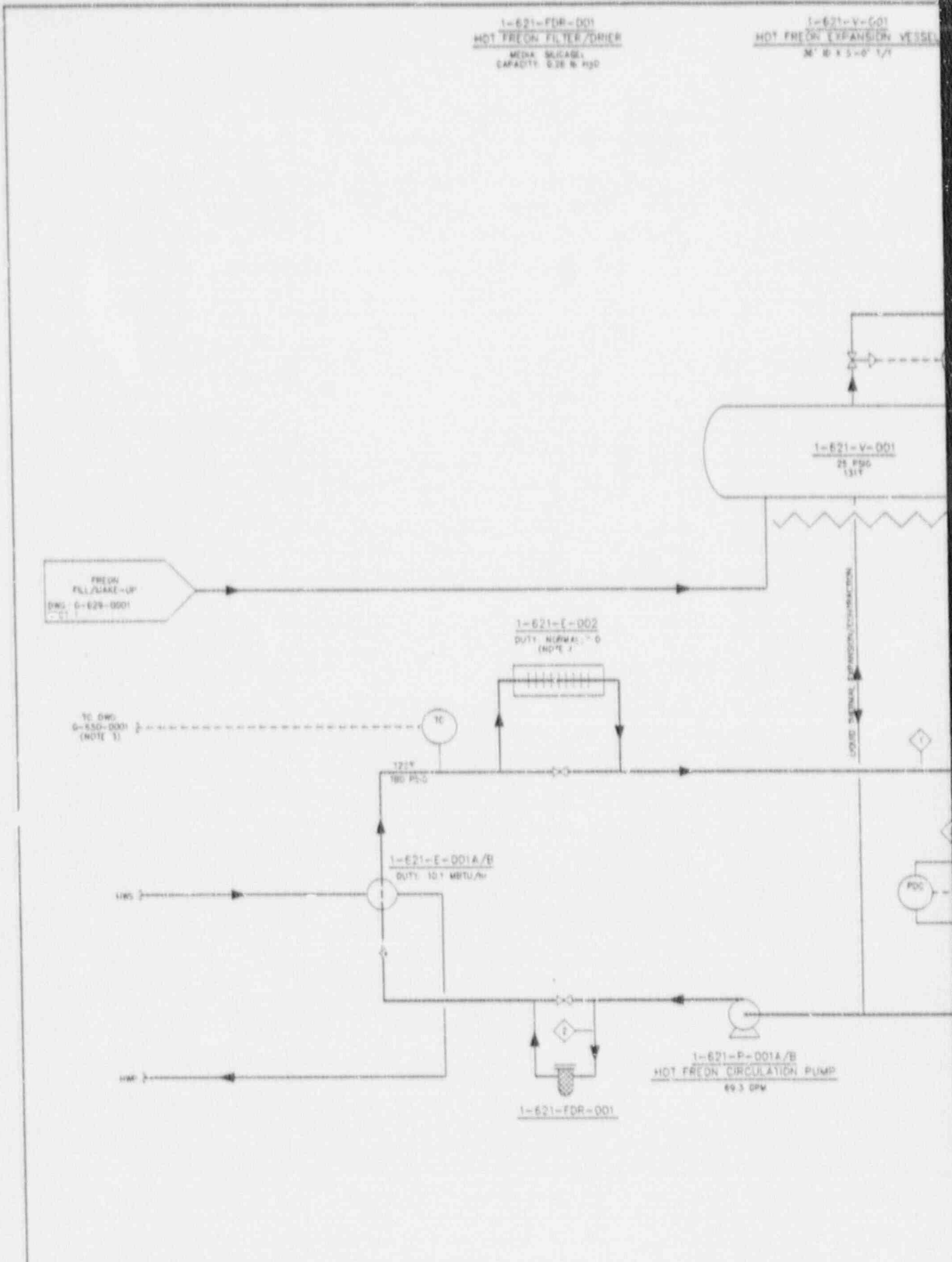
DWG NO. G-625-0001 REV.0	FRAME 1 OF 1
FLUOR DANIEL	LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER PROCESS FLOW DIAGRAM COLD REFRIGERANT SYSTEM Figure 3.2-17

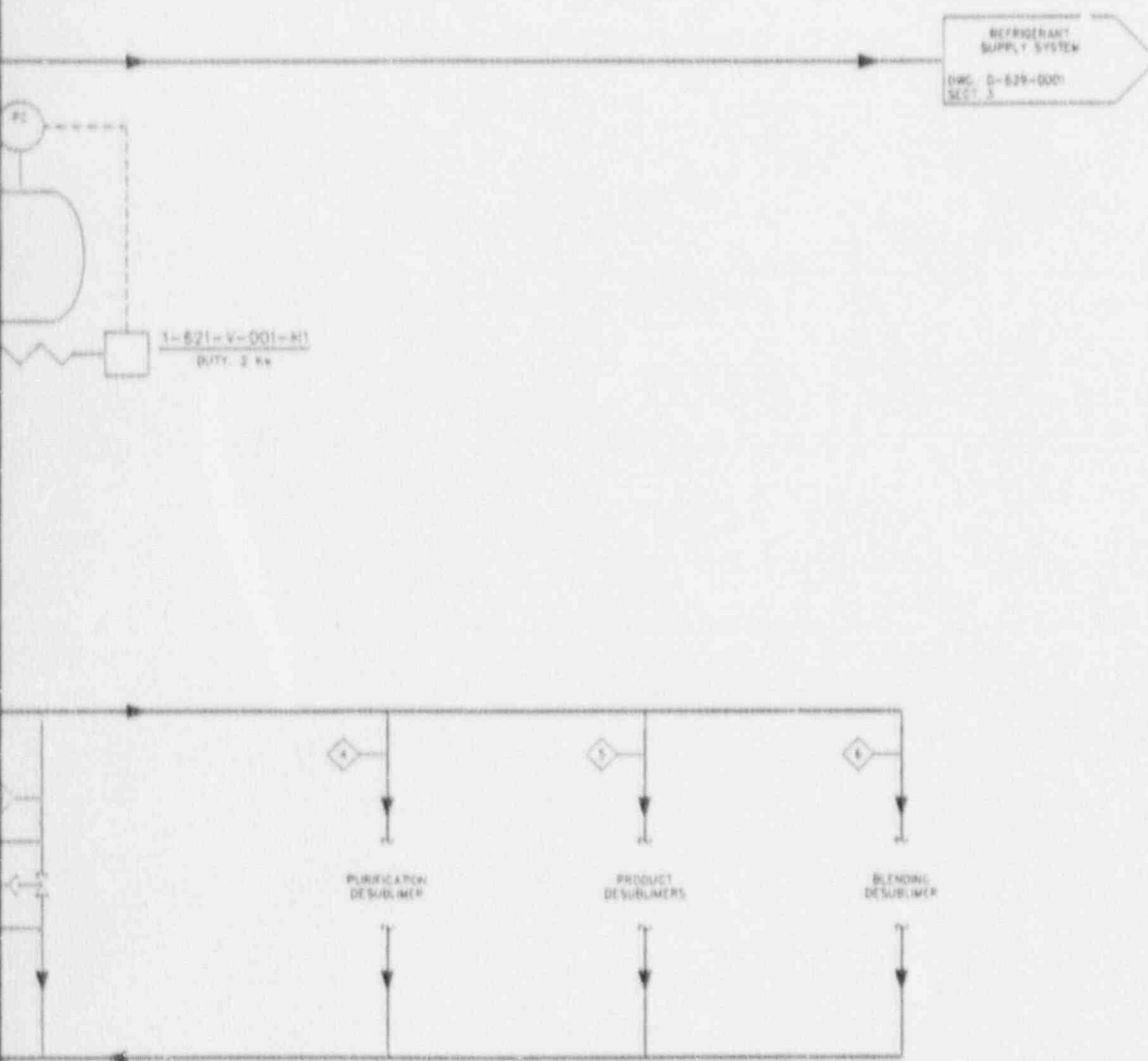
ACAD DF=ER3217

2



STREAM NUMBER	1	2	3	4	5	6
DESCRIPTION	CIRCULATING REFRIGERANT	FILTER/DRIER FLOW	BYPASS FLOW	HOT FREON	HOT FREON	HOT FREON
FREON R11, GPM	69.3	NORMALLY 0	29.7	26.4	5.5	6.5

3



NOTES:

1. SYSTEM SHOWN IS FOR PLANT UNIT 1.
2. SYSTEMS FOR PLANT UNITS 2 AND 3 ARE IDENTICAL EXCEPT FOR BLENDING DESUBLIMER WHICH EXISTS ONLY IN PLANT UNIT 1.
3. SEE DWG. D-650-0001 FOR CONTROL ACTION.
4. THE NEED FOR THIS COOLER WILL BE DETERMINED BY THE DETAILED DESIGN HEAT BALANCE.
5. ALL TEMPERATURES, PRESSURES, FLOWS AND COMPOSITIONS FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE "SYSTEM DESIGN BASIS", SDB 621.

DWG. NO. D-621-0001 REV.0 | FRAME 1 OF 1

FLUOR DANIEL

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

PROCESS FLOW DIAGRAM
HOT REFRIGERANT SYSTEM

Figure 3.2-18

2 1

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3.3 WASTE CONFINEMENT AND EFFLUENT CONTROL

The CEC, as a result of the enrichment process, produces small quantities wastes and effluent which are controlled to protect the health and safety of the public and the environment. This section describes the equipment and the design features incorporated into the plant which confine and control wastes and effluent, and which conserve depletable resources. A description of the wastes and effluent produced is provided, along with estimates of the quantities released or disposed of.

3.3.1 CONTROL AND CONSERVATION

Of primary importance to the CEC is the control of uranium hexafluoride (UF6). The UF6, which is the material processed to achieve enrichment, readily reacts with air, moisture, and some other materials. The most significant reaction products in this plant are hydrogen fluoride (HF), uranyl fluoride (UO2F2), and small amounts of uranium tetrafluoride (UF4). Of these, HF is the most significant hazard, being toxic to humans.

The features and systems described below serve to limit, collect, confine, and treat wastes and effluent which result from the UF6 enrichment process. A number of chemicals and processes are used in fulfilling this function. As with any chemical/industrial facility, a wide variety of waste types result. The control of all types of wastes and effluent is addressed below. Additionally, the features and systems used for conservation of depletable resources are also described below.

3.3.1.1 Equipment and Design Features

The equipment and design features incorporated in the CEC are selected to keep the release of gaseous and liquid effluent contaminants as low as practicable, and within regulatory limits. They are also selected to minimize the use of depletable resources.

3.3.1.1.1 Limiting Effluent Releases

Equipment and design features for limiting effluent releases during normal operation are described below. Potential effluent releases due to postulated accidents are shown to be limited in Section 5.1.

a. The process systems which handle UF6 operate almost entirely at sub-atmospheric pressures. Such operation results in no outward leakage of UF6 to any effluent stream.

b. The one location where UF6 pressure is raised above atmospheric pressure is in the piping and cylinders inside the autoclave. The pressure is still very low (26.1 psia). The piping and cylinders inside the autoclaves confine the UF_6. In the event of leakage, the autoclave provides secondary containment of UF_6. The higher pressure piping also is separated from the remainder of the piping by a fail-closed valve.

c. Cylinders of UF_6 are transported only when cool and when the UF_6 is in solid form. This minimizes risk of inadvertent release due to mishandling.

d. Process off-gas, from UF_6 purification and other operations, is discharged through desublimers to solidify and reclaim as much UF_6 as possible. Remaining gases are discharged through high-efficiency filters and chemical adsorbent beds. The filters and adsorbents remove HF and uranium compounds left in the gaseous effluent stream.

e. Liquids and solids in the process systems collect uranium compounds. When these liquids and solids (e.g. oils, damaged piping, or equipment) are removed for cleaning or maintenance, portions end up in wastes and effluent. Different processes are employed to separate uranium compounds and other materials (such as various heavy metals) from the resulting wastes and effluent. These processes are described in Section 3.3.2 below.

f. Processes used to clean up wastes and effluent create their own wastes and effluent as well. Control of these is also accomplished by liquid and solid waste handling systems and techniques, which are described in detail in Section 3.3.2 below. In general, careful application of basic principles for waste handling are followed in all of the systems and processes. Different waste types are collected in separate containers to minimize contamination of one waste type with another. Materials which can cause airborne contamination are carefully packaged; ventilation and filtration of the air in the area is provided as necessary. Liquid wastes are confined to piping, tanks, and other containers; curbing, pits, and sumps are used to collect and contain leaks and spills. Hazardous wastes are stored in designated areas in carefully labeled containers. Strong acids and caustics are neutralized before entering an effluent stream. Radioactively contaminated wastes are decontaminated insofar as possible to reduce waste volume.

g. Following handling and treatment processes to limit wastes and effluent, sampling and monitoring is performed to assure regulatory limits are not exceeded in effluent streams. Gaseous effluent is monitored before release; liquid effluent is sampled and/or monitored in liquid waste and sewage treatment systems; solid wastes are sampled and/or monitored prior to offsite treatment and disposal.

3.3.1.1.2 Conserving Depletable Resources

The CEC design serves to minimize the use of depletable resources. Water is the primary depletable resource used at the facility. Electric power usage also depletes fuel sources used in the production of the power. Other depletable resources are used only in small quantities. Chemical usage is minimized not only to conserve, but to preclude excessive waste production. Recyclable materials are used and recycled wherever practicable.

The main feature incorporated in the CEC to limit water consumption is the use of closed-loop cooling systems. The Main Plant Cooling Water System provides cooling to all operations requiring cooling in the Separations Building and the Standby Diesel Generator Building. This closed-loop cooling water system discharges its heat to the atmosphere via air-cooled chillers. Water for this system is only needed for fill and make up; no continuous water supply is required. Two other major systems cooled by this system are also closed-loop, including Machine Cooling Water and Spray Cooling Water. The Machine Cooling Water System serves to maintain the centrifuges within a specified operating temperature for maximum efficiency. The Spray Cooling Water System provides cooling water used for desubliming UF_6 in product, blending, tails, and purification cylinders.

The potable water system is by far the largest user of water. Section 3.5 of the CEC Safety Analysis Report (Reference 3.3-1) demonstrates that plant water usage is low relative to other users in the area and has no adverse impact on the area water supply.

Power usage is minimized by efficient design of lighting systems, selection of high efficiency motors, use of appropriate building insulation materials, and other good engineering practices. The demand for power in the process systems is a major portion of plant operating cost; efficient design of components is incorporated throughout the process systems.

3.3.2 EFFLUENT SYSTEMS

The following paragraphs provide a comprehensive description of the CEC systems which handle wastes and effluent. The effectiveness of each system for effluent control is discussed for all systems which handle and release effluent.

3.3.2.1 <u>Ventilation and Off-gas Systems</u>

Ventilation and off-gas systems in the CEC assure UF_6 and its reaction products are contained and controlled. The following systems are used in the plant.

3.3.2.1.1 UF6 Vent Systems

It is important to maintain the purity of UF6 throughout the enrichment process. The UF6 Feed, Product, and Blending systems are provided with means to vent impurities from UF6 cylinders. (The Tails system shares the Feed vent system as needed.) When the impure UF6 is vented, the gas passes through cold desublimers, which solidify and re-capture the UF6 for reuse. Almost all of the UF6 is solidified in the desublimers. Traces of UF6 may be carried further downstream, along with the reaction products HF and UO2F2.

Downstream of the desublimers, the vent systems are equipped with traps to collect the HF, UO2F2, any back-diffusing vacuum pump oil, and the traces of carried-over UF6. Chemical traps contain both activated carbon and activated alumina, an oil trap also contains activated alumina, and another oil trap contains activated carbon. Gases passed through these traps are cleaned and discharged to the Gaseous Effluent Vent System (also described below), and the contaminants (UF6, UO2F2, HF, and oil) are retained in the traps. (When the traps are loaded, they are handled as solid wastes, as described in Section 3.3.2.3 below.) In the entire plant, the Feed systems have three vent trains, the Product systems have nine vent trains, and the Blending system has one vent train. The Feed, Product, and Blending systems along with their vent systems are illustrated schematically in the figures included with Section 3.2.

The vent systems effectively contain effluent contaminants since almost all vented UF6 is collected in the desublimers. The traps are also designed to efficiently collect any remaining contaminants. Finally, the Gaseous Effluent Vent System provides final assurance of contaminant control by filtering the vent gases through very high efficiency HEPA and activated carbon filters before release to the atmosphere.

3.3.2.1.2 Mobile Pump Sets

Several mobile pump sets are provided throughout the plant for UF6 system venting needs due to maintenance, operation, and sampling activities. These systems are very similar in principle to the UF6 vent systems described immediately above. The design of the pump set systems varies according to the application. The systems may consist of nitrogen cold traps for UF6 capture and re-use, as well as traps to collect HF, vacuum pump oil, and traces of UF6. As with the UF6 vent systems, traps contain activated carbon and/or activated alumina. Gases passed through these traps are cleaned and discharged to the Gaseous Effluent Vent System, and the contaminants (UF6, UO2F2, HF, and oil) are retained in the traps. When the traps are loaded, they are handled as solid wastes, as described in Section 3.3.2.3 below.

Similarly to the UF6 vent systems, the Mobile Pump Sets utilize efficient traps to contain the effluent contaminants. The gases discharged from these pump sets also are filtered in very high efficiency HEPA and activated carbon filters in the Gaseous Effluent Vent System, prior to discharge to the atmosphere.

3.3.2.1.3 Contingency Dump System

The Contingency Dump System provides a means to remove the contents of the Centrifuge Enrichment System cascades when other means of evacuation are unavailable. The system is not expected to operate for the entire life of the plant. This dump system pulls the cascade contents through a sodium fluoride (NaF) trap to remove UF6 and any HF contaminant. The gases are then pumped through an activated alumina oil trap and on to the Gaseous Effluent Vent System. The NaF and activated alumina traps retain UF6, HF, UO2F2, and oil. Loaded traps are handled as solid waste, as described in Section 3.3.2.3 below. One NaF trap is provided for each cascade, and one of two activated alumina traps are shared by the seven cascades of an assay unit.

The traps in this system are sized and designed to efficiently contain effluent contaminants. Most of the UF6 is collected before HF and UO2F2 can form. Vent gases are filtered in the Gaseous Effluent Vent System prior to release to the atmosphere.

3.3.2.1.4 Portable Ventilation Units

Portable ventilation units do not actually discharge effluent from the CEC, but are described since they do treat air which is eventually discharged. The units provide local filtration of air primarily during maintenance activities. They consist of a blower, a HEPA filter, and a flexible hose, conveniently grouped on a portable cart. Typical use is for local filtration during change-out of filters contaminated with UO2F2 dust. The UO2F2 and any other contaminants are collected in the HEPA filter, and the cleaned air is exhausted to the room. When the filters are loaded they are handled as solid waste, as described in Section 3.3.2.3.

These units are used for air with very low amounts of contamination. The efficient HEPA filters provide added assurance of worker protection from local airborne contaminants.

3.3.2.1.5 Building Ventilation

A number of self-contained HVAC systems serve the various areas of the Separations Building. Areas which normally have a potential for release of UF6 are maintained under slightly negative pressure. This assures that the air flow direction is from areas of little or no potential for radioactive contamination to areas of higher potential for contamination.

These areas are illustrated in Figure 3.3-1, Separations Building Ventilation Zones, EL 100'-6", and Figure 3.3-2, Separations Building Ventilation Zones, EL 115'-0". Only one ventilation system (described below) filters air for UF6 and its reaction products. It serves a portion of the Technical Services Area, and exhausts through the plant stack after filtration for contamination. All other HVAC systems circulate air directly from and to the environment, with only particulate filtration incorporated for air cleaning.

The TSA HVAC System filters air from potentially contaminated areas of the TSA, such as the Decontamination Workshop, the Contaminated Workroom, the Radioactive Waste Storage Area, and other areas. The TSA HVAC System is illustrated schematically in Figure 3.3-3, Flow Diagram - TSA HVAC System. The system incorporates standard particulate filters, activated carbon filters, and HEPA filters to remove UO2F2, UF4, HF, and trace uranium compounds from the air. No contaminated air is returned through cooling coils, so system condensate cannot become contaminated. The cleaned air is discharged to the plant stack, and the contaminants are collected on the filters. The filters are handled as solid waste, as described in Section 3.3.2.3.

The high efficiency HEPA filters used effectively remove and contain effluent contaminants from the air prior to release.

3.3.2.1.6 Gaseous Effluent Vent System

The Gaseous Effluent Vent System performs final monitoring and cleanup of gaseous streams before discharge to the atmosphere. The systems described above, excluding the Portable Ventilation Units and the filtered TSA HVAC System, all discharge through this system. In addition, fume hoods from the TSA, flexible hose connections and miscellaneous services throughout the plant tie into this system. After final treatment in this system, gaseous effluent releases are monitored to verify contamination levels are witnin limits. The system is shut down if limits are exceeded; only an insignificant volume of off-spec air is released if this occurs.

The Gaseous Effluent Vent System is illustrated schematically in Figure 3.3-4, Flow Diagram - Gaseous Effluent Vent System. The system uses five air pre-filters, five HEPA filters, and five activated carbon filters (impregnated with potassium carbonate) for final effluent cleanup. The potassium carbonate increases the activated carbon filter efficiency. Residual UF6, UO2F2, HF, and other contaminants entering the system are retained by the very high efficiency filters. The cleaned air and gases are discharged to the atmosphere. (Experience in Urenco plants in Europe illustrates that annual uranium discharge from the Gaseous Effluent Vent System is less than 10 grams/year.) The filters are handled as solid waste, as described in Section 3.3.2.3.

Specifications for the filters in this system are provided in Table 3.3-1, Gaseous Effluent Vent System Filter Specifications.

3.3.2.1.7 Main Plant Cooling Water Chiller Exhaust Air

Plant thermal effluent (heat) is discharged to the atmosphere via the Main Plant Cooling Water System air cooled chillers. The heated air is discharged directly to the environment. The primary sources of thermal effluent are the HVAC systems, the UF_6 centrifuges, and the autoclaves.

3.3.2.2 Liquid Wastes and Effluent Handling

Liquid wastes and effluent are generated in a number of processes throughout the plant. All liquid effluent discharged from the plant is eventually handled in the Yard Drain System or the Sewage Treatment System. A noteworthy input to the Sewage Treatment System is discharge from the Liquid Waste Disposal System. Each of these three systems is described in the following sections.

A diagram summarizing all aqueous liquid waste collection, treatment, and discharge is provided in Figure 3.3-5, Combined Diagram of Aqueous Liquid Effluent Systems. Non-aqueous liquid wastes are handled separately on a case-by-case basis, and are not represented on the diagram.

3.3.2.2.1 Yard Drain System

The Yard Drain System collects rainwater runoff and water from clean drains throughout the CEC site. Drainage is collected in a Hold-Up Basin. The Hold-Up Basin controls the release rate of water to reduce the possibility of downstream flooding. It also provides a point for periodic sampling of the water. A flow diagram of the system is provided in Figure 3.3-6, Flow Diagram - Yard Drain System.

The Yard Drain System collects drainage from the following:

a. Yard drains from all areas inside the security fence, including the tails storage area

b. Roof drains from the Office Building and the Separations Building

c. Roof and floor drains from the Centrifuge Assembly Building, the Pump House, the Standby Diesel Generator Building, and the Cylinder Receipt and Dispatch Building

Locations of the above buildings and areas are shown on Figure 3.1-2, Facilities, Buildings, Areas, and Yard.

Liquid effluent streams that pose a risk of exceeding environmental release limits during normal plant operation are not collected by the Yard Drain System. (Those which may routinely require treatment are routed through the Liquid Waste Disposal System and/or the Sewage Treatment System.) There is no automatic termination of releases from the Hold-Up Basin because normally there are no inputs that could exceed the release limits. A manual valve is provided on the Hold-Up Basin discharge line to allow termination of any release from the basin.

No attempt is made to control the flow rate into the Hold-Up Basin. The effluents are released from the basin continuously at the flow rate created by the elevation of the water in the pond.

The contents of the Hold-Up Basin are sampled monthly, and are composited and analyzed quarterly. Analysis is performed to detect gross alpha and beta activity. Records are maintained for documentation and trending purposes. Samples are taken, analyzed, and recorded more often when the plant first goes into operation. Samples are also taken if there is a significant unexpected change in the sample and analysis results, or if some other circumstance occurs which may cause a significant change in the composition of the drains.

The administrative limits for alpha and beta activity are set more strictly than the regulatory limits. This provides a buffer that informs the plant operators of unacceptable trends and excursions before regulatory limits could be exceeded. The difference between the administrative limit and the regulatory limit is selected so that the plant operators can respond appropriately to prevent exceeding regulatory limits. The administrative limit is set at 80% of the regulatory limit. Both administrative and regulatory limits are listed in Table 3.3-2, Radioactivity Limits for Hold-Up Basin Releases.

3.3.2.2.2 Sewage Treatment System

The Sewage Treatment System is designed to process domestic sewage to meet effluent water quality standards set forth by the Louisiana Department of Environmental Quality and the U. S. Environmental Protection Agency. The system serves the Centrifuge Assembly Building, Separations Building, Office Building, and Cylinder Receipt and Dispatch Building. (See Figure 3.1-2, Facilities, Buildings, Areas, and Yard, for building locations.) The Sewage Treatment system is illustrated schematically in Figure 3.3-7, Flow Diagram - Sewage Treatment System.

Plant domestic sewage drains into one of four lift stations. From the lift stations, the sewage is pumped to a sewage treatment area. The incoming raw sewage flows through a grit settling chamber, a bar screen, a comminutor, and an aeration treatment unit. The sewage is decomposed in the treatment unit by aerobic bacteria in the presence of air. The decomposed sewage is then chlorinated, if necessary, to meet release limits. The effluent is then released through a monitor to Bluegill Pond.

In addition to handling raw sewage, the Sewage Treatment System also receives discharges from the Liquid Waste Disposal (LWD) System. LWD effluent must meet specific release limits prior to discharge to this system, as described in the next section. The Sewage Treatment System serves as a final treatment and monitoring point for both sanitary and LWD effluent.

3.3.2.2.3 Liquid Waste Disposal System

Liquid wastes and effluent which require processing or liquid wastes which are unsuitable for release are handled in the Liquid Waste Disposal (LWD) System. System components are located within the Technical Services Area (TSA) of the Separations Building. Liquid wastes and effluent are routed to effluent collection tanks or are collected in other suitable containers. The liquids are analyzed, processed as required, and, if regulatory limits are met, are discharged from the site via the Sewage Treatment System.

Actual processing in the LWD system is mostly performed by an outside contractor. Wastes requiring processing generally are those potentially contaminated with radioactive material. Wastes unsuitable for release are disposed of offsite in accordance with regulations for hazardous or radioactive waste disposal, as appropriate. Wastes are transported offsite for disposal by contract carriers. Transportation is in compliance with 49 CFR 107 through 49 CFR 400 (Reference 3.3-2).

Liquid wastes and effluent may be aqueous or non-aqueous. Due to differences in treatment and handling requirements, aqueous and non-aqueous liquids are addressed separately below.

3.3.2.2.3.1 Aqueous Liquid Wastes and Effluent

Aqueous liquid wastes and effluent are collected in various tanks throughout the Separations Building. Tank contents are sampled, processed as required, and released. The wastes are released only after meeting regulatory limits for water quality. Release of the wastes is always via the Sewage Treatment System for final analysis, treatment, and monitoring. Any wastes which cannot be made suitable for release are disposed of offsite in accordance with hazardous waste or radioactive waste disposal regulations, as appropriate.

A set of flow diagrams showing the waste handling process is provided in Figure 3.3-8, Flow Diagram - Aqueous Liquid Waste Collection and Disposal. Since waste treatment is generally performed by a contractor, these flow diagrams do not detail waste treatment processes.

Fourteen collection tanks are located throughout the Separations Building for collecting aqueous liquids. Two effluent collection tanks are provided for each plant unit, and are located in the effluent pits shown on Figure 3.3-9, Separations Building Floor Plan. The other eight collection tanks are in the Tank Room or in the TSA Effluent Pit in the Technical Services Area, also shown on Figure 3.3-9. The eight in the TSA include two effluent collection tanks, two decontamination effluent monitor tanks, two citric acid collection tanks, and two laundry effluent monitor tanks. The effluent collected by each tank is described in more detail further below.

Except for the laundry tanks, effluent flow into the tanks is by gravity feed. (Effluent is pumped into the laundry tanks.) Tanks are sized so that normal flow to any tank is collected for at least one to two weeks with no operator action. Level instrumentation and alarms are provided to indicate when a tank is full and requires operator attention.

Full effluent tanks are mixed by recirculating the contents using a tank transfer pump. After mixing, the tank contents are sampled and analyzed to determine if the contents of the tank can be released to the Sewage Treatment System. The water contamination levels and water quality parameters necessary for release are listed in Table 3.3-3, Radioactivity Limits for Liquid Waste Releases, and Table 3.3-4, Water Quality Limits for Liquid Waste Releases. Batches which meet these limits are forwarded to the Sewage Treatment System. Batches which do not meet the limits are retained for further processing. The latter are held in either the citric acid collection tanks or transferred to one of two liquid waste collection tanks.

Effluent which requires processing is stored until sufficient liquid is accumulated to justify a processing run. Effluent batches from different sources are not mixed unless the processing requirements are similar. When sufficient volume is accumulated, an offsite contractor provides portable equipment for processing. The waste water is pumped from the effluent tank, through the portable process equipment, and into one of two liquid waste monitor tanks. The processed water is then mixed by recirculation, sampled, and analyzed to determine if the contents of the tank can be released to the Sewage Treatment System.

Batch processing of aqueous liquid wastes provides an effective means of assuring that effluent releases are controlled and maintained within limits. Rapid isolation of releases is not required since batches are not released until analysis shows contaminants are within release limits.

Contractor waste processing equipment is expected to consist of various combinations of filters, demineralizers, and evaporators. The exact equipment configuration will depend upon the particular characteristics of the effluent batch. The equipment is set up in a dedicated portion of the Truck Bay. Processing of the effluent normally consists of uranium and/or oil removal. By-products of waste processing (i.e. filter media, demineralizer resin, etc.) will be handled by the contractor. Contents of the fourteen tanks and significant processing requirements are noted below.

a. Effluent Collection Tanks: Six effluent collection tanks are provided to collect aqueous wastes from the floor drains, equipment drains, and service sinks in the UF6 Handling Area of the Separations Building. These tanks do not normally require treatment before release.

b. Technical Services Area Effluent Collection Tanks: Two TSA effluent collection tanks are provided to collect aqueous wastes from floor drains, equipment drains, and service sinks in the Technical Services Area of the Separations Building. Nitric acid is also added to these tanks from sinks in the Chemical Laboratory. The two tanks are located in the TSA effluent pit. They are provided with connections to be used for pH control. Caustic or acid is manually added through these connections to neutralize the tank contents. These tanks normally require pH adjustment, but do not normally require any other treatment before release.

c. Citric Acid Collection Tanks: Two citric acid collection tanks are provided to collect used citric acid solutions from the citric acid baths, the citric acid sink, and the wet blast cabinet in the Decontamination System. The tanks are located in the TSA effluent pit. These tanks routinely require processing for pH adjustment and uranium removal. Uranium is removed by a contractor by precipitation or evaporation. For uranium precipitation, potassium hydroxide is added; uranium then precipitates as potassium diuranate. Since decontamination processes remove metallic fluorides as well as uranium compounds, heavy metals may also accumulate in amounts unacceptable for release. Heavy metals precipitate out with the uranium precipitate and so do not contribute significantly to the contaminants in plant effluent streams.

d. Decontamination Effluent Monitor Tanks: Two decontamination effluent monitor tanks are provided in the TSA to collect used decontamination water from the rinse water baths in the Decontamination System. The tanks are located in the TSA effluent pit. The tanks are provided with connections to be used for pH control. Caustic or acid is manually added through these connections to neutralize the tank contents. These tanks normally require pH adjustment, but do not normally require any other treatment before release.

e. Laundry Effluent Monitor Tanks: Two laundry effluent monitor tanks are provided to collect drains from the contaminated laundry washing machines in the Contaminated Laundry System. The tanks are located in the TSA Tank Room. These tanks only occasionally require processing for uranium removal prior to release.

3.3.2.2.3.2 Non-Aqueous Liquid Wastes and Effluent

Non-aqueous liquids are collected throughout the plant, and are identified, stored, and prepared for treatment or disposal. Some aqueous wastes which cannot be mixed with the effluents described above are also handled with non-aqueous wastes. The next paragraphs describe in general terms the methods for handling these liquids. Immediately following the general description are details applicable to each specific type of hazardous or radioactive waste produced in the plant.

The following non-aqueous liquid wastes are collected in the LWD System:

a. Lubrication oils: Oils are collected from maintenance of process equipment, plant vehicles, and from workshop activities.

b. Solvents: Solvent waste is produced in the Decontamination System, in laboratories, workshops, and during centrifuge assembly.

c. Laboratory chemicals: Waste chemicals are produced in the Chemical, Environmental, and Health Physics labs.

Wastes are collected manually in appropriate containers. Wastes that are potentially contaminated with radioactive materials are transferred to the Radioactive Waste Storage Area of the TSA. Wastes that are not contaminated with radioactive materials are transferred to the Hazardous Waste Area of the TSA. The locations of these areas is provided on Figure 3.3-9, Separations Building Floor Plan. Liquid waste storage areas are curbed to contain leaks and spills. Safe handling is not threatened by temporary loss of electric power, instrument air, or any other utilities.

The volumes of waste generated and stored on site are maintained within the limits for a small quantity generator in 40 CFR 262 (Reference 3.3-6, Subpart C). All wastes generated are Class A low-level wastes as defined in 10 CFR 61 (Reference 3.3-3).

3.3.2.2.3.2.1 Radioactive Wastes

Potentially radioactive liquid wastes that have been transferred to the Radioactive Waste Storage Area are sampled and analyzed to determine the quantity and the isotopic distribution of any radioactive material found. The wastes are then properly labeled as required by 10 CFR 61 (Reference 3.3-3, parts 61.55 and 61.57). If no radioactive material is found, the waste is transferred to the general Storage Area of the TSA.

Radioactive wastes are packaged before they are stored in the Radioactive Waste Storage Area. The type of packaging depends on what level of processing the waste will receive. Wastes that are to be shipped offsite to a Central Volume Reduction Facility (CVRF) for processing are packaged according to the rules of the CVRF and in accordance with 49 CFR 173 (Reference 3.3-4). Wastes that are to be processed onsite or which may be stored for some time are packaged so that handling is simplified, leakage will not occur, and accidental criticality is prevented. Wastes from different sources are not mixed (unless the processing requirements for both wastes are similar) in order to minimize processing difficulties.

Radioactive wastes are normally shipped offsite to a Central Volume Reduction Facility for processing. Any effluent processing which is performed onsite is in either the Radioactive Waste Storage Area or the Truck Bay. Wastes resulting from effluent processing are shipped to a low-level radioactive waste disposal facility.

3.3.2.2.3.2.2 Non-Radioactive Wastes

Non-radioactive liquid wastes that have been transferred to the Storage Area of the TSA are sampled and analyzed to determine if they are hazardous according to 40 CFR 261 (Reference 3.3-5). The wastes are then properly labeled. Non-hazardous wastes are disposed of in accordance with good industry practice.

Non-radioactive wastes are packaged before they are stored onsite. These wastes are stored in the TSA in either the Storage Area or the Hazardous Waste Area. These areas are shown on Figure 3.3-9, Separations Building Floor Plan. Packaging for hazardous wastes is in accordance with 40 CFR 262, 49 CFR 173, and 49 CFR 179 (References 3.3-6, 3.3-4, and 3.3-7, respectively). Packaging for non-hazardous wastes is according to good industry practice. Wastes from different sources are not mixed (unless the processing requirements are similar) in order to minimize processing difficulties. Incompatible wastes are not mixed to preclude chemical reaction accidents.

Hazardous wastes are shipped offsite to a hazardous waste disposal facility. No onsite processing of hazardous wastes is normally performed other than neutralization of acids and caustics. Non-hazardous wastes are disposed of in accordance with good industry practice and applicable codes and regulations.

3.3.2.2.3.2.3 Waste Types

The following paragraphs describe the methods for handling each of the major non-aqueous liquid wastes produced in the plant, including oils, solvents, and laboratory chemicals.

Oil is manually collected in various parts of the plant where it is used for lubrication of equipment. Oil from radioactively contaminated sources is collected separately from noncontaminated oil sources. Non-contaminated oil is transferred to the Hazardous Waste Area. It is sampled and stored in labeled two-gallon plastic containers or 30 to 55 gallon drums. The non-contaminated oil is then shipped to a waste oil recycling facility for processing and disposal.

Potentially contaminated oil is transferred to the Radioactive Waste Storage Area. It is sampled and stored in appropriately labeled containers. Administrative controls on storage preclude criticality accidents. The contaminated oil may be solidified on site, or is shipped offsite to a Central Volume Reduction Facility for volume reduction. The resulting wastes are packaged and shipped to a low-level radioactive waste disposal facility.

Solvents used in the Decontamination System are distilled to remove contaminated sludge from reusable solvents. The oily sludge is transferred to the LWD System, sampled, and stored in the Radioactive Waste Storage Area. Administrative controls on storage preclude criticality accidents. The sludge is then shipped to a Central Volume Reduction Facility for volume reduction, with the resulting waste packaged and shipped to a low-level radioactive waste disposal facility.

Non-contaminated solvents are recycled using both onsite and offsite distillation equipment. Disposal of solvents that cannot be recycled are handled by a contracted solvent disposal facility. Storage of these solvents will be in the Hazardous Waste Area.

A large portion of chemical laboratory waste is organic solvent which contains uranium. The solvents used are tributyl phosphate, carbon tetrachloride, toluene, and n-n dihexylacetamide. Uranium can be extracted from these solvents in laboratory processes through the use of sodium bicarbonate (for the first two solvents) and sodium carbonate with hydrogen peroxide (for the latter two). After uranium extraction, the remaining solvent is transferred to the Hazardous Waste Area. The extracted uranium compounds are packaged for disposal.

Other laboratory chemicals that cannot be neutralized and disposed of with the aqueous wastes are packaged in appropriate containers and are transferred to the Hazardous Waste Area. The chemicals are packaged in shipping containers and sent to an authorized hazardous waste disposal facility.

3.3.2.3 Solid Waste Handling

Small amounts of solid wastes are produced in a number of plant activities and require a variety of methods for treatment and disposal. Solid wastes are categorized into wet solid waste and dry solid waste due to differences in storage and disposal requirements found in 40 CFR 264 (Reference 3.3-9) and 10 CFR 61 (Reference 3.3-3), respectively. Dry wastes are defined as in 10 CFR 61 (Reference 3.3-3, Subpart 61.56 (a)(3)), containing "as little free standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume." Wet wastes, for this plant, are defined as those which have as little free liquid as reasonably achievable but with no limit with respect to percent of volume.

Waste volumes generated and stored will not exceed the limits for a small quantity generator in 40 CFR 262 (Reference 3.3-6, Subpart C). All solid wastes generated are Class A low-level wastes as defined in 10 CFR 61 (Reference 3.3-3). Wastes are transported offsite for disposal by contract carriers. Transportation is in compliance with 49 CFR 107 through 49 CFR 400 (Reference 3.3-2).

The Solid Waste Disposal "System" is simply a group of methods and procedures applied as appropriate to the various solid wastes. Each individual waste is handled differently according to its unique combination of characteristics and constraints. Wet and dry waste handling is described separately below. (Wastes produced by waste treatment vendors are handled by the vendors and are not addressed here.)

3.3.2.3.1 Wet Solid Wastes

The wet waste portion of the Solid Waste Disposal System handles all radiological, hazardous, and industrial solid wastes from the plant which do not meet the above definition of dry waste. This portion handles several types of wet waste: wet trash, oil recovery sludge, wet abrasive materials, oil filters, resins, and miscellaneous hazardous wastes. The system collects, identifies, stores, and prepares these wastes for shipment.

Wet solid wastes are segregated into radioactive, hazardous, or industrial waste categories during collection to minimize disposal problems. Radioactive waste contains radioactive materials in concentrations above the limits specified in 10 CFR 20 (Reference 3.3-8). Hazardous waste contains hazardous materials defined in 40 CFR 261 (Reference 3.3-5), in concentrations above prescribed limits. Industrial waste is not classified as either radioactive or hazardous. However, industrial waste that is mixed with hazardous or radioactive waste must be handled as either hazardous or radioactive waste, as appropriate.

The Solid Waste Disposal System involves a number of manual steps. The steps for handling each wet waste type are described below, addressing separately the handling of radioactive, hazardous, and industrial waste.

3.3.2.3.1.1 Wet Trash

In this plant trash typically consists of waste paper, pack. material, clothing, rags, wipes, mop heads, and absorption me. Wet trash consists of trash that contains water, oil, or chemical solutions.

Generation of radioactive wet trash is minimized insofar as possible. Trash with radioactive contamination is collected in specially marked plastic-bag-lined drums. These drums are located throughout each Radiation Control Zone. Wet trash is collected in separate drums from dry trash. When the drum of wet trash is full, the plastic bag is removed from the drum and sealed. The bag is then checked for leaks and excessive liquid, and the exterior is monitored for contamination. If necessary, excess liquids are drained and the exterior is cleaned. The bag is then taken to the Radioactive Waste Storage Area where the waste is identified, labeled, and recorded. Two options are available for onsite handling of wet radioactive trash:

a. The trash is removed from the plastic bag and the trash is placed on a drying rack. This rack allows the free liquid to drain from the trash and into the floor drain system to the LWD System. The trash is then collected in another plastic bag and included with dry radioactive trash.

b. If the trash is being shipped to a Central Volume Reduction Facility (CVRF) that can handle wet trash, the wet trash is not handled separately from dry trash. The CVRF reduces the volume of the trash and then repackages the resulting waste for disposal. The waste package is then shipped to a radioactive waste disposal facility. Collected radioactive trash is stored in an appropriate container in the Radioactive Waste Storage Area until it can be shipped offsite for treatment or disposal.

Trash with hazardous contamination is collected in specially marked plastic bags. Wet trash is collected separately from dry trash. When full, the plastic bag containing wet trash is removed from the drum, sealed, the exterior monitored for hazardous material, and the exterior cleaned if necessary. The bag is then taken to the Hazardous Waste Area, identified, labeled, and recorded. All hazardous trash is stored in the Hazardous Waste Area until it is shipped to a hazardous waste disposal facility. Different types of hazardous materials are not mixed so that accidental reactions will not occur.

Empty containers that at one time contained hazardous materials are a special type of hazardous waste, as discussed in 40 CFR 261 (Reference 3.3-5, Subpart 261.7). After such a container is emptied, it is resealed and taken to the Hazardous Waste Area for identification, labeling, and recording. The container is handled as hazardous waste and is shipped to a hazardous waste processing facility for cleaning and/or disposal. Alternately, the container is used to store compatible hazardous wastes and to ship those wastes to a hazardous waste processing facility for processing and container disposal.

Industrial trash is collected in specially marked receptacles in all parts of the plant. Trash that contains free liquids is dewatered before it is put into a receptacle. The trash from Radiation Control Areas is collected in plastic bags and taken to the Radioactive Waste Storage Area of the TSA for inspection to ensure that no radioactive contamination is present. (See Figure 3.3-9, Separations Building Floor Plan, for location of the TSA and the storage areas.) The inspected trash and the trash from outside Radiation Control Areas are then taken to one of several dumpsters around the plant. The trash is stored in these dumpsters until it is transported to a local landfill by a contract carrier.

3.3.2.3.1.2 Oil Recovery Sludge

The process for recovering used Fomblin oil generates an oily sludge which must be disposed of. The sludge results from the absorption of hydrocarbons in activated carbon and diatomaceous earth. A contracted radioactive waste processor may solidify the wastes in drums using Portland cement along with a binder. Alternatively, the waste may be shipped offsite to a Central Volume Reduction Facility for volume reduction. Regulations and technology current at the time of waste production will dictate treatment methods. In either case the waste is finally disposed of at a licensed low-level radioactive waste disposal facility.

3.3.2.3.1.3 Wet Abrasive Materials

Glass beads are used in the Decontamination System to wet blast adhering radioactive contamination from components. Periodically the beads are replaced, thus requiring disposal of the used beads. The used beads are dewatered and packaged for disposal. The packaged beads are transferred to the Radioactive Waste Storage Area for storage while awaiting treatment and/or disposal. The beads may be decontaminated and shipped to a landfill, shipped directly to a radioactive waste disposal facility, or shipped with other radioactive trash to a CVRF for volume reduction and disposal.

3.3.2.3.1.4 Oil Filters

Used oil filters are collected from the diesel generators and from plant vehicles. No filters are radioactively contaminated. The used filters are placed in containers and transported to the Hazardous Waste Area of the TSA. (See Figure 3.3-9, Separations Building Floor Plan.) There the filters are drained completely and transferred to a drum. (The drained waste oil is combined with other waste oil and handled as described in Section 3.3.2.2.3.) Once a drum is full, a sample is taken, one to two inches of absorbent material is added, and then the drum is sealed and labeled. The drum is then shipped to an offsite hazardous waste disposal contractor for disposal.

3.3.2.3.1.5 Resins

Spent resin is collected from the Machine Cooling Water system polishers and from the Utility Water System softener. No resins become radioactively contaminated. Resin disposal may be handled by a contractor. The resins are dewatered and are disposed of in a landfill.

3.3.2.3.1.6 Miscellaneous Hazardous Wastes

Small quantities of wet solid hazardous wastes are generated by normal plant activities. These wastes consist of waste lab chemicals, oil-soaked rags, used absorption media, etc. These materials are collected separately and stored in the Hazardous Waste Area. There, the wastes are identified, labeled, and recorded. Precautions are taken to prevent accidental reactions during storage and handling. The materials are stored in the Hazardous Waste Area until they are shipped to a hazardous waste processing facility for treatment and disposal.

3.3.2.3.2 Dry Solid Wastes

The dry waste portion of the Solid Waste Disposal System handles all dry radiological, hazardous, and industrial solid wastes from the plant. These wastes include: trash, activated carbon, activated alumina, activated sodium fluoride, HEPA filters, scrap metal, silica gel, salt, other hazardous materials. The system collects, identifies, stores, and prepares these wastes for shipment.

Waste volumes generated and stored do not exceed the limits for a small quantity generator in 40 CFR 262 (Reference 3.3-6, Subpart C). All solid wastes generated are Class A low-level wastes as defined in 10 CFR 61 (Reference 3.3-3).

The Solid Waste Disposal System involves a number of manual steps. The steps for handling each dry waste type are described below, addressing separately the handling of radioactive, hazardous, and industrial waste.

3.3.2.3.2.1 Trash

Dry trash sources are the same as the wet trash sources, and dry trash is handled in much the same way as wet trash. Section 3.3.2.3.1.1 describes the handling of wet trash and should be referred to for details. Only the differences between wet and dry trash handling are provided below.

Steps to remove liquids are of course unnecessary for dry trash. The dry waste portion of the Solid Waste Disposal System accepts wet trash that has been dewatered, as well as dry trash.

Radioactive trash may be compacted on site, or may be shipped to a Centralized Volume Reduction Facility, (CVRF). The CVRF reduces the volume of the trash and then repackages the resulting waste for disposal. Waste compacted on site or handled by the CVRF will be disposed of in a radioactive waste disposal facility.

Trash containing hazardous material is handled as described above with the wet waste portion of the Solid Waste Disposal System.

Aerosol spray cans may be disposed of as trash if they are first totally discharged and then punctured. Special receptacles for spray cans used in the Separations Building are provided and each can is inspected for radioactive contamination, total discharge, and puncture before it can be included with industrial trash.

3.3.2.3.2.2 Activated Carbon

Activated carbon is used in a number of systems to remove uranium compounds and HF from exhaust gases. Due to the potential hazard of airborne contamination, personnel respiration equipment is used during activated carbon handling to prevent inhalation of material by plant personnel. Spent or aged carbon is carefully removed, immediately packaged to prevent the spread of contamination, and transported to the Radioactive Waste Storage Area of the TSA. There the activated carbon is removed and placed in an appropriate container to preclude criticality. The contents of the containers are sampled to determine the quantity of HF and quantity and isotopic distribution of uranium present. The container is then sealed, monitored for external contamination, and properly labeled. It is then temporarily stored with radioactive trash. A container with a large mass of U235 is shipped directly to a low-level radioactive waste disposal facility. Containers with relatively little U235 are sent to a CVRF to reduce the volume of the waste, and the CVRF then repackages the resulting waste for shipment to a low-level radioactive waste disposal facility.

3.3.2.3.2.3 Activated Alumina

Activated alumina is used in a number of systems to remove hydrogen fluoride (HF) and UF6 from exhaust gases. Spent or aged alumina is carefully removed from system components, packaged to prevent the spread of contamination, and transported to the Radioactive Waste Storage Area of the TSA. There the activated alumina is removed and placed in an appropriate container. The contents of a full container are sampled to determine the quantity and isotopic distribution of uranium present. The container is then sealed, the exterior is monitored for contamination, and the container is properly labeled. It is stored in the Radioactive Waste Storage Area until it is shipped to a radioactive waste disposal facility.

Activated alumina is also used as a desiccant in the Plant/Instrument Air System. This alumina is not radioactively contaminated and is non-hazardous. It is disposed of in a landfill.

3.3.2.3.2.4 Activated Sodium Fluoride

Activated sodium fluoride (NaF) is used in the Contingency Dump System to remove UF6 and HF from exhaust gases. The Contingency Dump System is not expected to operate during the life of the plant. However, if the system is used often and the NaF saturates, the NaF is removed by personnel wearing respirators and using special procedures for personnel protection. A plastic bag is placed over the vessel and sealed, and the vessel is turned upside down to empty the NaF. Spent contaminated NaF, if ever produced, is processed by a contractor to remove uranium so the wastes may be disposed of. It is expected that NaF will not require treatment and disposal until decommissioning. (UF6 reacts with sodium fluoride to form sodium octofluor uranate (Na2UF8). The contractor would be expected to use one of two methods for uranium removal. One heats the Na2UF8 to 750 F, reversing the reaction of NaF and UF6. The other hydrolyzes the compound, filters out sodium fluoride, and precipitates uranium with ammonia. The precipitate is removed by filtration, and the waste solution is neutralized, sampled, analyzed, and released.)

3.3.2.3.2.5 Filter Elements

Prefilters and HEPA filters are used in several places throughout the plant to remove dust and dirt, uranium compounds, and hydrogen fluoride.

Filters in the Centrifuge Assembly Building are used to remove dust and dirt from the incoming air to ensure the cleanliness of the centrifuge assembly operation. When removed from the housing, the filter elements are wrapped in plastic to prevent the loss of particulate matter. These filter elements are not contaminated with radioactive or hazardous materials so disposal is with industrial trash.

Filters used in the Gaseous Effluent Vent System and the TSA HVAC System are used to remove HF and trace uranium compounds from the exhaust airstream. When the filter elements become loaded, they are removed from the housings and wrapped in plastic bags to prevent the spread of radioactive contamination. Due to the hazard of airborne contamination, either portable ventilation equipment or personal respiration equipment is used during filter element handling to prevent the intake of material by plant personnel. The filter elements are taken to the Radioactive Waste Storage Area of the TSA where a sample is taken to determine the quantity and isotopic distribution of uranium present. The exterior of the bag is monitored for contamination and the package is properly marked. The filter elements are either sent to a CVRF for processing or are compacted onsite and shipped to a low-level radioactive waste disposal facility.

Portable ventilation units are used to remove radioactive particles from the air during maintenance activities. The filter elements used in these units are handled as described immediately above for the Gaseous Effluent Vent System filter elements.

Portable ventilation units are also used to remove welding fumes. The filter elements are handled as industrial trash unless the ventilation unit is used in a Radiation Control Area or a Radiation Control Zone. These filter elements are removed from the unit, wrapped in plastic, and taken to the Radioactive Waste Storage Area to be sampled for uranium compounds. If they are found to be non-contaminated they are handled as industrial trash. If they are found to be contaminated they are handled as described above for the Gaseous Effluent Vent System filter elements.

Air filters from the Plant/Instrument Air system and the Diesel Generators are handled as industrial waste.

3.3.2.3.2.6 Scrap Metal

Metallic wastes are generated during routine and abnormal maintenance operations. The metal can be either clean, can be contaminated with radioactive material, or can contain hazardous material. Radioactive contamination of metal is always in the form of surface contamination caused by uranium compounds adhering to the metal or caught in cracks and crevices. No process in this facility results in activation of any materials.

Clean scrap metal is collected in bins located outside the Technical Services Area of the Separations Building. This material is transported by contract carrier to a local scrap metal vendor for disposal. Items collected outside of Radiation Control Areas or Radiation Control Zones are disposed of as industrial scrap metal unless there is reason to suspect it contains hazardous material.

Scrap metal is monitored for contamination before it leaves the site. Metal found to be contaminated is either decontaminated or disposed of as radioactive waste. When feasible, decontamination is the preferred method.

Decontamination is performed in situ for large items and in the Decontamination Workshop for smaller items. Decontamination of large items should not be required until the end of plant life. If onsite decontamination is not feasible the item is usually shipped offsite to a decontamination vendor who decontaminates the item and returns it to the plant. After decontamination, the item is inspected again for radioactive contamination and handled as industrial scrap metal if the contamination has been removed. Items that are not suitable for decontamination are inspected to determine the quantity of uranium present, packaged, labeled, and shipped either to a CVRF or a radioactive waste disposal facility. Some items may be compacted onsite prior to shipment.

Metallic items containing hazardous materials (as defined in 40 CFR 261 (Reference 3.3-5)) are collected at the location of the hazardous material. The items are wrapped to contain the material and taken to the Hazardous Waste Area. The items are then cleaned onsite if practical. If onsite cleaning cannot be performed then the items are sent to a hazardous waste processing facility for offsite treatment or disposal.

3.3.2.3.2.7 Silica Gel

Silica gel desiccants are used in driers in various refrigerant systems throughout the plant. The desiccants do not become radioactively contaminated. When spent, the silica gel is disposed of in a landfill.

3.3.2.3.2.8 Salt

Brine is rejected from the Utility Water System water softeners. The water softeners use a resin to remove calcium from the well-water. Spent resin is regenerated with a strong solution of sodium chloride (NaCl). The brine replaces Na on the resin, and removes calcium. Following resin regeneration, the brine is evaporated to extract the salt as a solid. The remaining salt (sodium chloride and calcium chloride (CaCl2)) is non-hazardous and non-contaminated. It is packaged and disposed of in a landfill.

3.3.2.3.2.9 Miscellaneous Hazardous Waste

Small quantities of dry solid hazardous wastes will be generated by normal plant activities. These may include waste lab chemicals, unused sodium fluoride, and other materials. These materials are collected, sampled, and stored in the Hazardous Waste Area in the TSA. Precautions are taken when collecting, packaging, and storing to prevent accidental reactions. These materials are shipped to a hazardous waste processing facility where the wastes will be prepared for disposal.

3.3.2.4 <u>Reprocessing and Recovery Systems</u>

Systems used to allow recovery or reuse of materials are described below.

3.3.2.4.1 Fomblin Oil Recovery System

Fomblin oil is an expensive, highly fluorinated, inert oil selected especially for use in uranium hexafluoride (UF6) systems to avoid reaction with UF6. The Fomblin Oil Recovery System recovers used Fomblin oil from pumps used in UF6 systems. All Fomblin oil is recovered; none is normally released as waste or effluent.

Used Fomblin oil is recovered by removing impurities that inhibit the oil's lubrication properties. The impurities collected are primarily uranyl fluoride (UO2F2) and uranium tetrafluoride (UF4) particles. The recovery process also removes trace amounts of hydrocarbons, which if left in would react with UF6. The Fomblin Oil Recovery System components are located in the Decontamination Workshop in the TSA, which is shown in Figure 3.3-9, Separations Building Floor Plan. The total annual volume of oil to be processed in this system is approximately 80 gallons.

The Fomblin oil recovery process consists of oil collection, uranium precipitation, trace hydrocarbon removal, oil sampling, and storage of cleaned oil for re-use. Each step is performed manually. A diagram demonstrating the process is provided in Figure 3.3-10, Logic Diagram - Fomblin Oil Recovery System.

Fomblin oil is collected in the Contaminated Equipment Workshop as part of the pump disassembly process. The oil is transferred for processing to the Decontamination Workshop in two-gallon plastic containers. The containers are labeled so each can be tracked through the process. Used oil awaiting processing is stored in the Fomblin oil storage array to eliminate the possibility of accidental criticality.

Uranium compounds are removed from the Fomblin oil in the Fomblin oil fume hood to minimize personnel exposure to airborne contamination. Dissolved uranium compounds are removed by the addition of anhydrous sodium carbonate (Na_2CO_3) to the oil container which causes the uranium compounds to precipitate into sodium uranyl carbonate ($(Na_2)_4UO_2(CO_3)_3$). The mixture is agitated and then filtered through a coarse screen to remove metal particles and small parts such as screws and nuts. These are transferred to the Solid Waste Disposal System. The oil is then heated to 210-220 F and stirred for 90 minutes to speed the reaction. The oil is then centrifuged to remove UF_4, sodium uranyl carbonate, and various metallic fluorides. The particulate that is removed from the oil is combined with a citric acid solution, forming a uranyl citrate solution. This solution, which totals about 40 gallons a year, is transferred to a citric acid collection tank in the LWD System for disposal.

Trace amounts of hydrocarbons are removed in the Fomblin oil fume hood next by adding activated carbon to the Fomblin oil and heating the mixture at 215-250 F for two hours. The activated carbon absorbs the hydrocarbons, and the carbon in turn is removed by filtration through a bed of 30-80 mesh diatomaceous earth. The resulting sludge is transferred to the Solid Waste Disposal System for disposal.

Recovered Fomblin oil is sampled. Using an extraction process with carbon tetrachloride (CCl_4), the samples are analyzed in the Chemical Laboratory to determine if the criteria for purity have been met. Oil that meets the criteria can be re-used in the system while oil that does not meet the criteria will be reprocessed. The following limits have been set for recovered Fomblin oil purity for re-use in the plant:

Uranium - 50 ppm by volume or 30 ppm by weight

Hydrocarbons - 3 ppm by volume or 2 ppm by weight

Used CCl_4 is separated, collected, and transferred to the LWD System for disposal. Approximately two gallons of used CCl_4 is collected annually.

Recovered Fomblin oil is stored in two-gallon plastic containers in the Chemical Storage Area. No precautions are required to prevent criticality accidents during the handling and storage of clean Fomblin oil.

3.3.2.4.2 Refrigerant Recovery

The refrigerant systems do not normally discharge any refrigerant to the environment. The Refrigerant Supply System incorporates a two-stage vapor recovery unit which serves all refrigerant system expansion and storage vessels.

The vapor recovery unit accepts refrigerant from the expansion or storage vessels during any off-normal operating mode which causes vessel venting. In the first stage of the unit, vented refrigerant is condensed, and in the second stage it is subcooled. The first stage (vapor condenser) employs circulating cooling water for desuperheating and condensation. The second stage (condensate subcooler) uses cold refrigerant to effect the subcooling.

3.3.2.4.3 Decontamination System

The Decontamination System is designed to remove radioactive contamination from contaminated materials and equipment. It is described here with other recovery systems since it allows some equipment and materials to be reused rather than discarded. The description should also be useful for understanding what chemicals are introduced in to the citric acid collection tanks and the decontamination effluent monitor tanks, described above in the aqueous liquids handling section.

The only significant forms of radioactive contamination found in the plant are uranium hexafluoride (UF_6), uranium tetrafluoride (UF_4), and uranyl fluoride (UO_2F_2). These are removed from items in the Decontamination System. Most of the process of decontamination is performed in the Decontamination Workshop of the TSA. (See Figure 3.3-9, Separations Building Floor Plan, for the location.)

The Decontamination System consists of a series of steps including equipment disassembly, degreasing, decontamination, drying, and inspection. Items from UF_6 systems, waste handling systems, and miscellaneous other items are decontaminated in this system. Components commonly decontaminated include pumps, valves, piping, instruments, sample bottles, tools, and scrap metal. Sample bottle decontamination is handled under a special procedure due to the difficulty of handling the specific shape of the bottle. The decontamination process for most plant components is described immediately below. Following the general process description, sample bottle decontamination is addressed separately. Two diagrams are provided to illustrate the decontamination process, in Figure 3.3-11, Logic Diagram - Decontamination System, and Figure 3.3-12 Flow Diagram - Decontamination System.

3.3.2.4.3.1 General Decontamination

Disassembly of contaminated equipment is performed in the Contaminated Equipment Workshop in the TSA. During disassembly, Fomblin oil, hydrocarbon oil, and contaminated solids may be removed from equipment. These are collected separately and transferred to the Fomblin Oil Recovery System, the LWD system, and the Solid Waste Disposal System, respectively. Components are also degreased as necessary. Those needing degreasing are cleaned manually or are immersed in a solvent vapor degreasing unit. Degreased components are inspected and forwarded to be decontaminated.

The degreasing solvent is selected to be compatible with Fomblin oil, UF6, and the component material. Vapor recovery and solvent distillation are provided to minimize solvent use. Once uranium concentrations in the solvent reach specified limits, the solvent is distilled. Solvent residue is collected manually and transferred to the LWD system.

Decontamination follows disassembly and degreasing. Several methods are available for removal of contamination. These include manual cleaning, immersing in citric acid baths, and wet blasting with glass beads. The baths are provided with ultrasonic agitation capability. Typically, decontamination is accomplished by immersing the contaminated component in a citric acid bath. After 15 minutes the component is removed, and is flushed with water to remove the citric acid. A rinse water bath follows to remove residual citric acid. For adhering contamination, ultrasonic agitation and/or wet blasting is used along with the baths.

The baths are sampled periodically to determine the condition of the solution. The citric acid baths are analyzed for uranium concentration and citric acid concentration. A limit on U of 220 grams/liter of bath has been established to prevent criticality. Additional citric acid is added as necessary to keep the citric acid concentration between 5% and 7%. Spent solutions, consisting of citric acid, uranyl citrates, and metallic citrates are transferred to a citric acid collection tank in the LWD System. The rinse water baths are checked for satisfactory pH levels; unusable water is transferred to a decontamination effluent monitor tank in the LWD system.

All components are dried after decontamination. This is performed either manually or in a drying cabinet. The drying cabinet is vented to TSA HVAC system ductwork to control moisture.

The decontaminated components are inspected prior to unconditional release. The quantity of contamination remaining must be "as low as reasonably achievable". Components released for unrestricted use do not have contamination exceeding 1000 1000dpm/100cm^2 beta-gamma.

3.3.2.4.3.2 Sample Bottle Decontamination

Sample bottle decontamination is handled somewhat differently than the above general process. The Decontamination Workshop has a separate area dedicated to sample bottle storage, disassembly, and decontamination. Used sample bottles are weighed to confirm the bottles are empty. The valves are loosened, and then the remainder of the decontamination process is performed in the sample bottle decontamination fume hood. The valves are removed inside the fume hood. Any loose material inside the bottle or valve is dissolved in a citric acid solution. Spent citric acid is transferred to a citric acid collection tank in the LWD system.

Sample bottles and valves are flushed with a 10% ammonium carbonate solution. Ammonium carbonate reacts with UF_6 and UO_2F_2 to form ammonium uranyl carbonate and hydrogen fluoride. The bottles and valves are then rinsed with demineralized water. The procedure is repeated with a 5% ammonium carbonate solution and a small amount of hydrogen peroxide, followed by another rinse. The used solutions are drained to a citric acid collection tank. The bottles and valves are then flushed with a 10% nitric acid solution and rinsed with demineralized water. This used solution is drained to a TSA effluent collection tank in the LWD System. The bottles and valves are dried and inspected for contamination and rust. The cleaned components are transferred to the UF6 Equipment Workshop for reassembly and pressure testing.

3.3.2.4.3.3 Decontamination Equipment

The following major components are included in the Decontamination System:

a. Citric Acid Baths: Three citric acid baths are provided for the primary means of removing radioactive contamination. Two of the baths have a minimum liquid capacity of 450 gallons, and the third has a minimum capacity of 25 gallons. The baths drain to a citric acid collection tank. Bath vents exhaust to Gaseous Effluent Vent System ductwork to assure airborne contamination is controlled.

b. Rinse Water Baths: Three rinse water baths are provided to rinse excess citric acid from decontaminated components. Two of the baths have a minimum liquid capacity of 450 gallons, and the third has a minimum capacity of 25 gallons. The baths drain to a decontamination effluent monitor tank. Bath vents exhaust to Gaseous Effluent Vent System ductwork to assure airborne contamination is controlled.

c. Wet Blasting Cabinet: One wet blasting cabinet is provided to remove adhering radioactive contamination from components using a high pressure stream of demineralized water and glass beads. The effluent is drained to a citric acid collection tank. The vent exhaust is filtered and is discharged via the Gaseous Effluent Vent System ductwork. Used abrasive beads are handled with other solid radioactive waste.

d. Decontamination Degreasing Units: Two decontamination degreasing units are provided to remove grease and oil from contaminated components. The units are equipped with vapor recovery units and distillation stills.

e. Drying Cabinet: One drying cabinet is provided to dry components after decontamination. A vent is provided to exhaust moist air to TSA HVAC system ductwork.

3.3.2.4.4 Contaminated Laundry System

The Contaminated Laundry System cleans contaminated and soiled clothing and materials which have been used in Radiation Control Zones (RCZs) of the plant. It is described here with other recovery systems since it allows the reuse of clothing which otherwise would be discarded as radioactive waste. This system is not designed to handle clothing used in non-contaminated areas of the plant. The Contaminated Laundry System components are located in the Laundry Room of the TSA, which is shown on Figure 3.3-9, Separations Building Floor Plan.

The Contaminated Laundry System collects, cleans, dries, and inspects clothing and materials used in Radiation Control Zones (RCZs). Waste water is analyzed and transferred for treatment as necessary. The system consists of two washers, two dryers, and associated piping and controls. Expected contaminants on the laundry include UO_2F_2 and small amounts of UF_4.

The laundry normally handled by this system consists of the following:

a. Anti-contamination clothing used by plant personnel while working in RCZs (Anti-contamination clothing typically consists of coveralls, gloves, and shoe covers.)

b. Air suits used by plant personnel in RCZs with potentially high airborne contamination levels

The cleaning process uses 180 F minimum water, detergents, and bleach for dirt removal, odor removal, and disinfection of the laundry. The laundry is then dried with hot air. No "dry cleaning" solvents are used.

Contaminated laundry is collected in designated containers as personnel exit an RCZ. The collection containers are lined with plastic bags. When a container is full, its plastic bag is sealed, removed from the container and taken to the Contaminated Laundry Room. The contaminated laundry is removed from the bag and placed into a contaminated laundry washing machine and washed. Dirty laundry handling is performed adjacent to the laundry sorting hood for airborne contamination control. The washed laundry is dried in a contaminated laundry dryer and then is inspected for excessive wear. (Since contamination levels are very low, and since the primary contaminant, UO_2F_2, is water-soluble, monitoring of cleaned clothing for radioactive contamination is not performed.) Usable clothing is folded and returned to storage for reuse. Unusable clothing is sent to the Solid Waste Disposal System.

Waste water from the contaminated laundry washing machines is discharged to a laundry effluent monitor tank in the LWD system. Air from the laundry sorting hood is filtered and discharged from the plant through the Gaseous Effluent Vent System. The contaminated laundry dryers are vented to TSA HVAC system ductwork. Controlled discharge from the hood and the dryers helps control humidity, airborne particulate, and airborne contamination in the laundry room.

Items containing excess quantities of oil or chemicals (as defined by administrative procedures) are collected separately from contaminated laundry. These items, if not easily cleaned or treated, may simply be disposed of. Specified containers and procedures are used for collection, storage, and transfer of these items to the Solid Waste Disposal System.

3.3.3 EFFLUENT QUANTITIES

Quantities of radioactive and non-radioactive wastes and effluent are estimated in the tables following this section. The tables include quantities, and average and peak concentrations. Some wastes are treated or processed prior to disposal; this changes the waste characteristics and results in additional effluent discharge from the plant as well. The quantity of wastes in liquids are therefore provided both prior to treatment and after processing. (The constituents of gaseous effluent prior to treatment are in such small quantities that the differences before and after treatment are not informative.)

The first two tables address effluent: Table 3.3-5, Estimated Annual Liquid Effluent, and Table 3.3-6, Estimated Annual Gaseous Effluent. The next two address wastes: Table 3.3-7, Estimated Annual Non-Radiological Wastes, and Table 3.3-8, Estimated Annual Radiological Wastes. The last two address liquid effluent treatment: Table 3.3-9, Estimated Non-Aqueous Liquid Effluent Before Treatment or Discharge, and Table 3.3-10, Estimated Aqueous Liquid Effluent Before Treatment or Discharge.

REFERENCES FOR SECTION 3.3

1. Claiborne Enrichment Center Safety Analysis Report, Louisiana Energy Services, January, 1991.

2. Title 49, Code of Federal Regulations, Part 107 through Part 400, (Hazardous materials sections), 1989.

3. Title 10, Code of Federal Regulations, Part 61, Licensing Requirements for Land Disposal of Radioactive Waste, 1989.

4. Title 49, Code of Federal Regulations, Part 173, Shippers - General Requirements for Shipments and Packages, 1989.

5. Title 40, Code of Federal Regulations, Part 261, Identification and Listing of Hazardous Waste, 1989.

6. Title 40, Code of Federal Regulations, Part 262, Standards Applicable to Generators of Hazardous Waste, 1989.

7. Title 49, Code of Federal Regulations, Part 179, 1989.

8. Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, 1989.

9. Title 40, Code of Federal Regulations, Part 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 1989.

Table 3.3-1
Gaseous Effluent Vent System Filter Specifications

Filter	Specifications
Prefilter (particulate)	99.7% for > 5 microns (Class Q: > 95% efficiency)
HEPA filter	99.97% for > 0.3 microns (Class S: 99% for U compounds)
Activated carbon filter	99% for HF

Table 3.3-2
Radioactivity Limits for Hold-Up Basin Releases

The limits for radioactive materials in the basin are found in Table II of Appendix B to 10 CFR 20 (Reference 3.3-8). The administrative limits are set at 10% of the regulatory limits.

Isotope	Administrative Limits (microcuries/ml)	Regulatory Limits (microcuries/ml)
U-234	9 X 10E-6	9 X 10E-5
U-235	8 X 10E-6	8 X 10E-5
U-238	1 X 10E-5	1 X 10E-4

For each isotope determine the ratio between the concentration present and the limit listed above. The sum of the ratios for all isotopes shall be equal to or less than unity.

Table 3.3-3
Radioactivity Limits for Liquid Waste Releases

The limits for radioactive materials released to the Sewage Treatment System are referenced in 10 CFR 20 (Reference 3.3-8, Subpart 20.303). The limits are low to prevent the radioactive contamination of the Sewage Treatment System. The more stringent administrative limits (80% of regulatory limits) are imposed by the CEC to assure action can be taken prior to exceeding regulatory limits.

Isotope	Administrative Limits (microcuries/ml)	Regulatory Limits (microcuries/ml)
U-234	2.4 X 10E-5	3 X 10E-5
U-235	2.4 X 10E-5	3 X 10E-5
U-238	3.2 X 10E-5	4 X 10E-5

For each isotope determine the ratio between the concentration present and the limit listed above. The sum of the ratios for all isotopes shall be equal to or less than unity.

Table 3.3-4
Water Quality Limits for Liquid Waste Releases

The required water quality of the plant effluent is described in the Louisiana Administrative Code. The LWD effluent released to the Sewage Treatment System shall meet the limits listed below. Other limits are imposed on the Sewage Treatment System discharges and the Yard Drain System drainage. The more stringent administrative limits are imposed by the CEC to assure action can be taken prior to exceeding regulatory limits.

Parameter	Administrative Limits	Regulatory Limits
pH	6.5-8.0	6.0-8.5
Chlorides	≤30 ppm	≤50 ppm
Fluorides	(a)	none stated
Sulfates	≤10 mg/L	≤15 mg/L
Oil and Grease	≤15 mg/L	≤20 mg/L
Aluminum	(a)	none stated
Arsenic	≤0.050 mg/L	≤0.050 mg/L
Cadmium	≤0.006 mg/L	≤0.010 mg/L
Chromium	≤0.025 mg/L	≤0.050 mg/L
Copper	≤0.500 mg/L	≤1.000 mg/L
Iron	≤0.500 mg/L	≤1.000 mg/L
Lead	≤0.045 mg/L	≤0.050 mg/L
Nickel	≤0.080 mg/L	≤0.160 mg/L
Selenium	≤0.020 mg/L	≤0.035 mg/L
Silver	≤0.025 mg/L	≤0.050 mg/L
Zinc	≤0.050 mg/L	≤0.100 mg/L

(a) Appropriate limits are to be established in cooperation with the Louisiana Department of Environmental Quality.

Table 3.3-5
Estimated Annual Liquid Effluent

Liquid Effluent	Annual Quantity
LWD discharge	170,000 gal
Sanitary waste discharge	2,600,000 gal
Total discharge to Bluegill Pond	2,770,000 gal
Yard drain discharge	100,000,000 gal
Total discharge to Hold-Up Basin	100,000,000 gal
Constituents to Bluegill Pond	Concentration
Biocide	0.4 mg/l
Corrosion inhibitor	0.4 mg/l
Chlorine	≤ 1 mg/l
Fluorine	2.0 mg/l
Sulfur	(a)
Detergent	13 mg/l
Misc lab chemicals	18 mg/l
Uranium	17 mg/l
Metals	(a)
Constituents to Hold-Up Basin	Annual Quantity
Drain impurities (dirt)	not estimated

(a) These values are very small and are not estimated at their source. Plant effluents are monitored to confirm regulatory limits are not exceeded.

Table 3.3-6
Estimated Annual Gaseous Effluent

Gaseous Effluent	Annual Quantity
Gaseous Effluent Vent Sys. disch	2.0E9 scf/yr
HVAC systems discharge	4.4E10 scf/yr
Total gaseous discharge	4.6E10 scf/yr
Constituents	
Methanol (a)	33 lbs
Perchlorethylene (a)	22 lbs
Acetone (a)	220 lbs
Nitrogen	8.4E6 scf/yr
Hydrogen fluoride	< 14 lbs
Uranium (in compounds)	< 10 g
Combustion products	Trace
Thermal waste	78,000,000 Btu/hr

(a) During centrifuge assembly only.

Table 3.3-7
Estimated Annual Non-Radiological Wastes

Waste	Annual Quantity
Resins	21 ft^3
Silica gel	< 1 ft^3
Activated alumina	600 lbs
Oils	900 gal
Oil filters	100 lbs
Air filters	6500 lbs
Activated carbon	50 lbs
Salt	5200 lbs
Scrap metal	4400 lbs
Trash	44,000 lbs
Solvents	20 gal
Miscellaneous wet solids	120 lbs
Sewage sludge	12,000 lbs
Laboratory chemicals	500 gal
Methanol (a)	33 lbs
Perchlorethylene (a)	22 lbs

(a) During centrifuge assembly only.

Table 3.3-8
Estimated Annual Radiological Wastes

Type	Quantity	Uranium Content (lbs)
Activated Carbon	1500 lbs	120
Activated Alumina	350 lbs	4
Activated Sodium Fluoride	(a)	(a)
Ventilation Filters	1850 lbs	1
Demineralizer Resin (Vendor)	300 lbs	57
Waste Precipitate (Vendor)	1800 lbs	
Hydrocarbon Oil	25 gal	Trace
Solvent (Recovery Sludge)	25 gal	11
Laboratory Chemicals	750 gal	110
Miscellaneous Trash	16,000 lbs	22
Scrap Metal	290 lbs	Trace
Fomblin Oil Recovery Sludge	55 lbs	1
Decon System Abrasive Beads	600 lbs	6
TOTAL (rounded)		340

(a) No annual wastes. (The only application is in the Contingency Dump System, which has no annual usage.)

Table 3.3-9
Estimated Non-Aqueous Liquid Effluent Before Treatment or Discharge

Type	Annual Quantity	Resultant Waste	Waste Qty
Degreasing solvent	25 gals	sludge	25 gals
Lab chemicals (radiological)	750 gals	Uranium (in precipitate)	110 lbs
Lab chemicals (non-radiological)	500 gals	chemicals	500 gals
Fomblin oil	80 gals	sludge	55 lbs

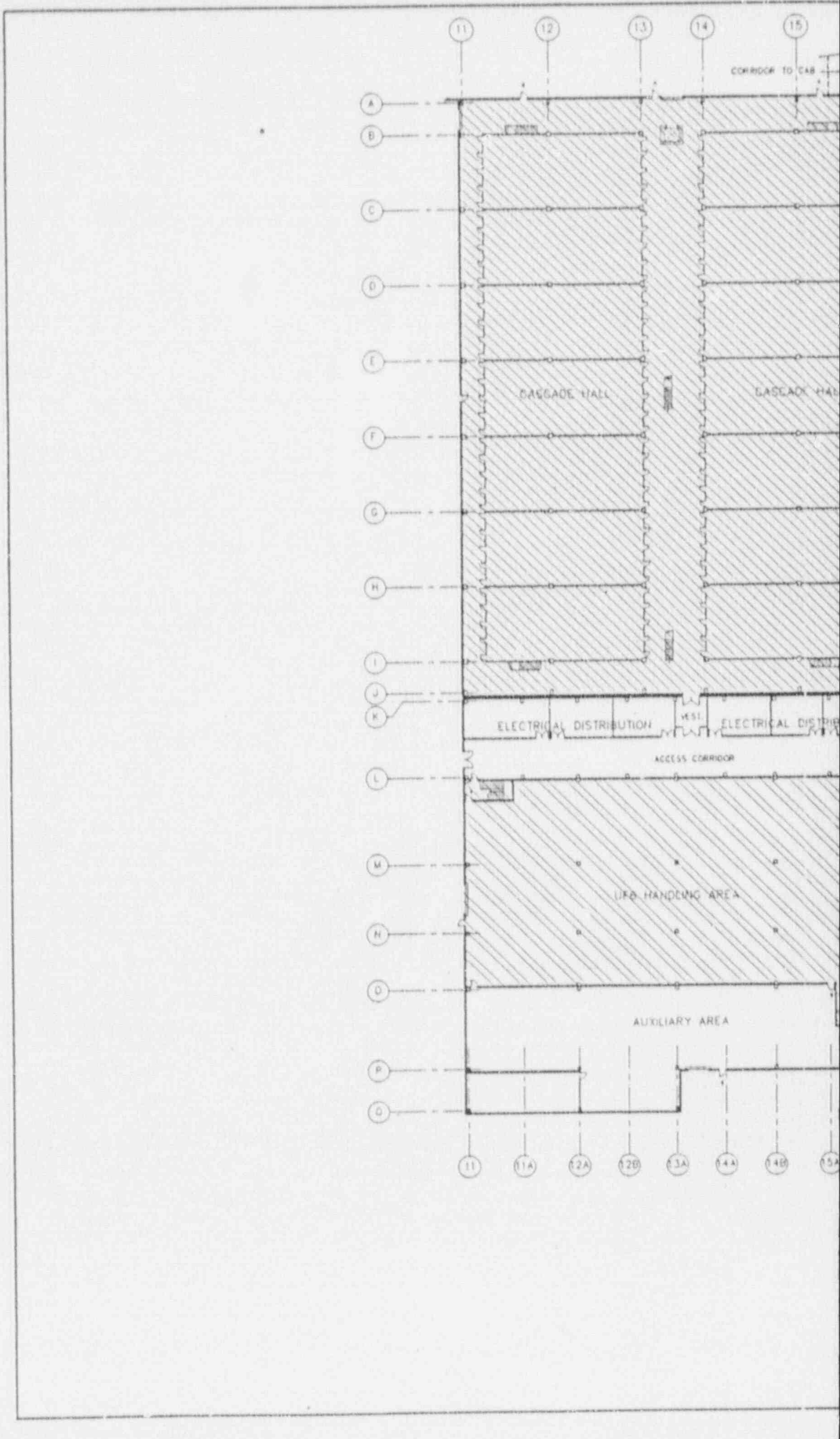
The above resultant wastes are disposed of offsite, and are included in Tables 3.3-7 or 3.3-8.

Table 3.3-10
Estimated Aqueous Liquid Effluent Before Treatment or Discharge
(Annual Basis)

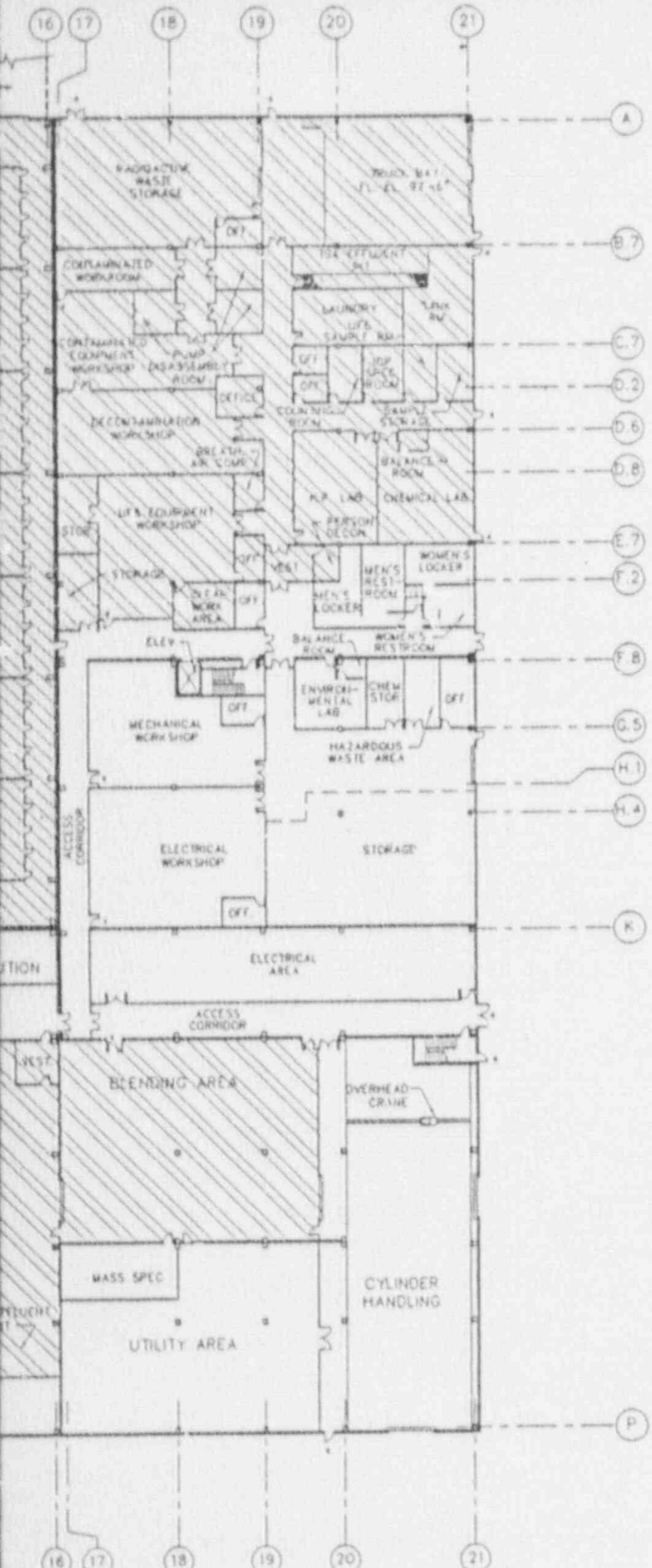
Tank	Volume (gal)	Contents	Concentration Avg (mg/l)	Peak
Citric acid collection tanks	4,000	Citric acid	5.1E4	7.2E4
		Uranyl citrates	2.1E3	1.5E4
		Metals	350	650
Decon effluent monitor tanks	8,500	Citric acid	0.03	0.06
		Uranyl citrates	1.2E-3	1.3E-2
		Metals	14	140
Laundry effluent monitor tanks	70,000	Detergents	520	1600
		Chlorine (from bleach)	49	150
		UO2F2	1.0	49
		UF4	0.26	13
TSA effluent collection tanks (ECTs)	46,000	Nitric acid	6900	3.1E5
		Uranyl nitrate	0.47	46
		Lab chemicals	(a)	(a)
		Oil	Trace	31
Unit ECTs	37,000	UO2F2	1.3	46

The above resultant wastes are disposed of offsite, and are included in Table 3.3-8. They are listed as "precipitate" and "demineralizer resin", both from vendor processes. The effluent from which the wastes are extracted is discharged onsite, and is included in Table 3.3-5. This effluent is listed as "LWD discharge."

(a) Normally 50 gallons/year of dilute chemical solutions. Actual chemical concentrations are low and are not estimated.



CORRIDOR TO CAB
CASCADE HALL
CASCADE HALL
ELECTRICAL DISTRIBUTION
VEST
ELECTRICAL DISTRI
ACCESS CORRIDOR
UF6 HANDLING AREA
AUXILIARY AREA



LEGEND

- ZONE A - POSITIVE PRESSURE
- ZONE B - NEUTRAL
- ZONE C - NEGATIVE PRESSURE

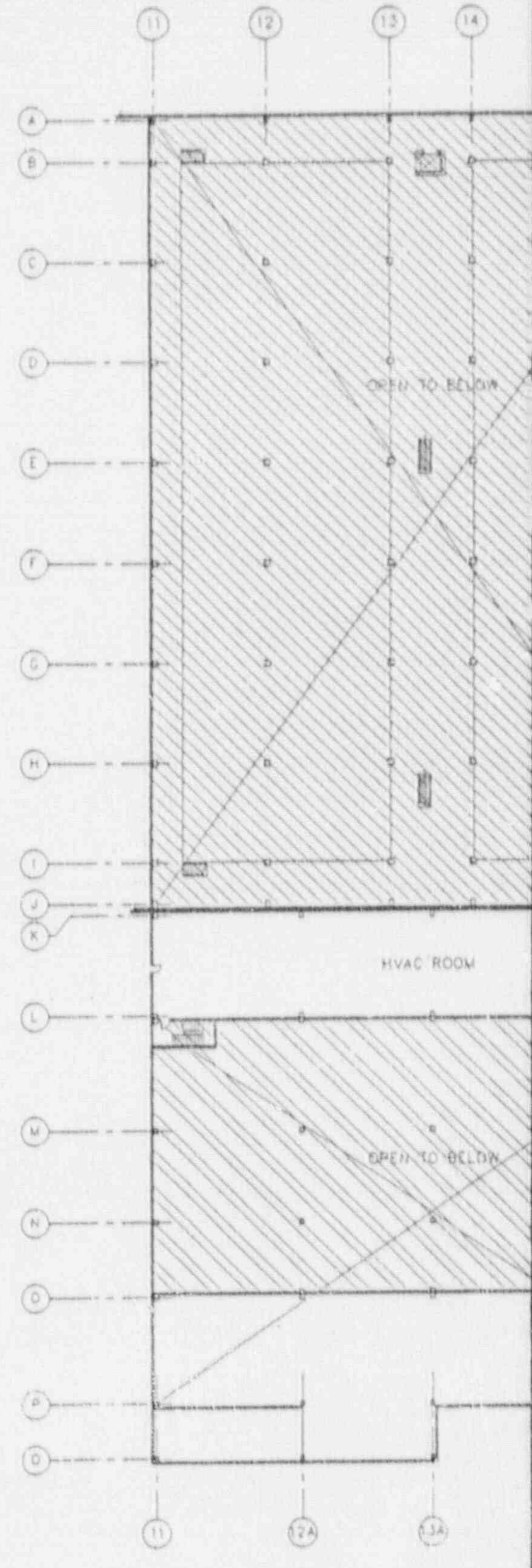
DWG NO. 4-90-0-8500 REV.02 | SHEET 1 OF 1

FLUOR DANIEL

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

SEPARATIONS BUILDING
VENTILATION ZONES
EL. 100'-6"
Figure 3.3-1



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HVAC ROOM
OPEN TO BELOW
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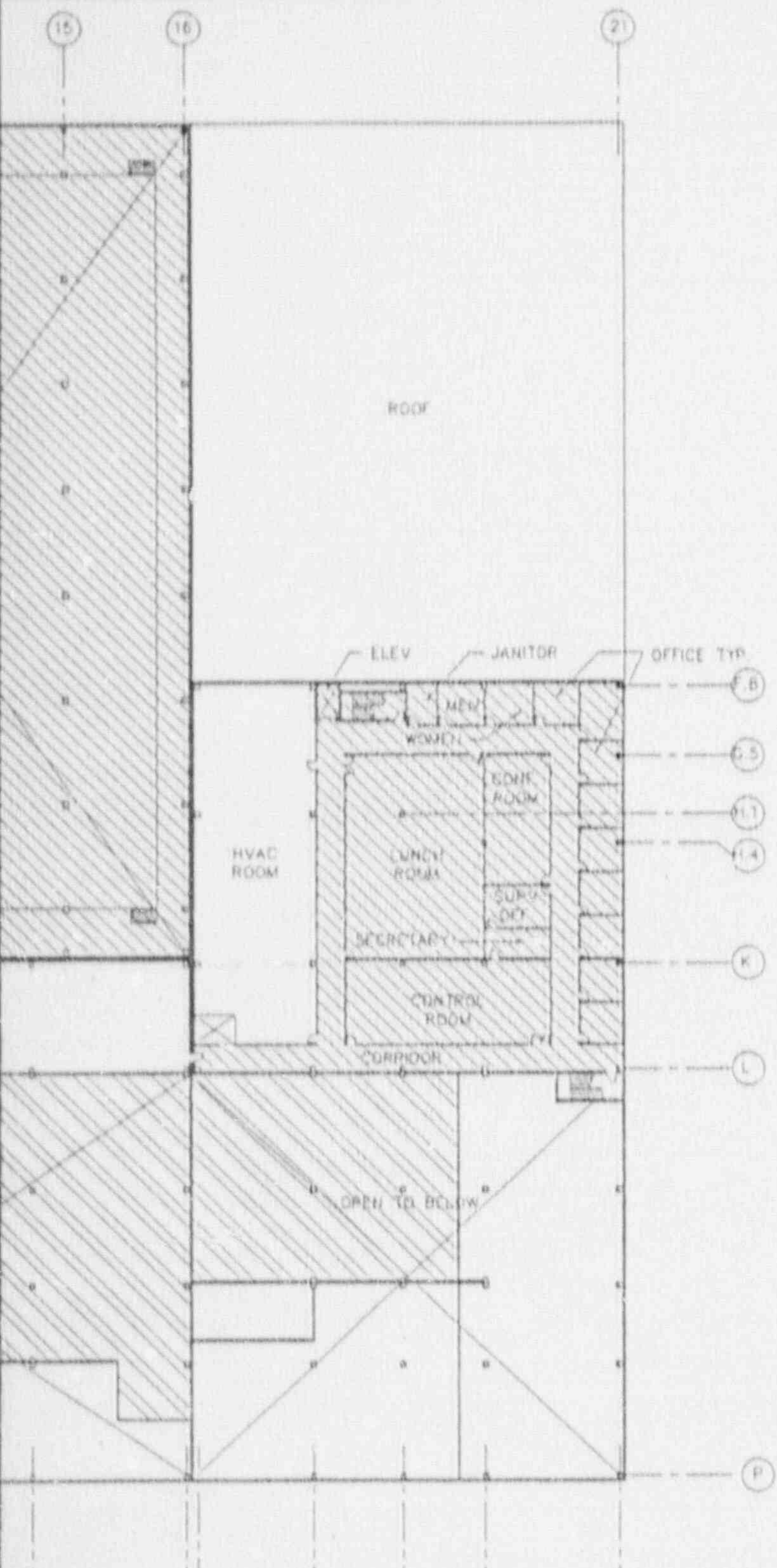
13A



SI APERTURE CARD

Also Available On Aperture Card

LEGEND

ZONE A - POSITIVE PRESSURE

ZONE B - NEUTRAL

ZONE C - NEGATIVE PRESSURE

9102060114-33

DWG. NO. 4-90-0-8501 REV.02 | SHEET 1 OF 1

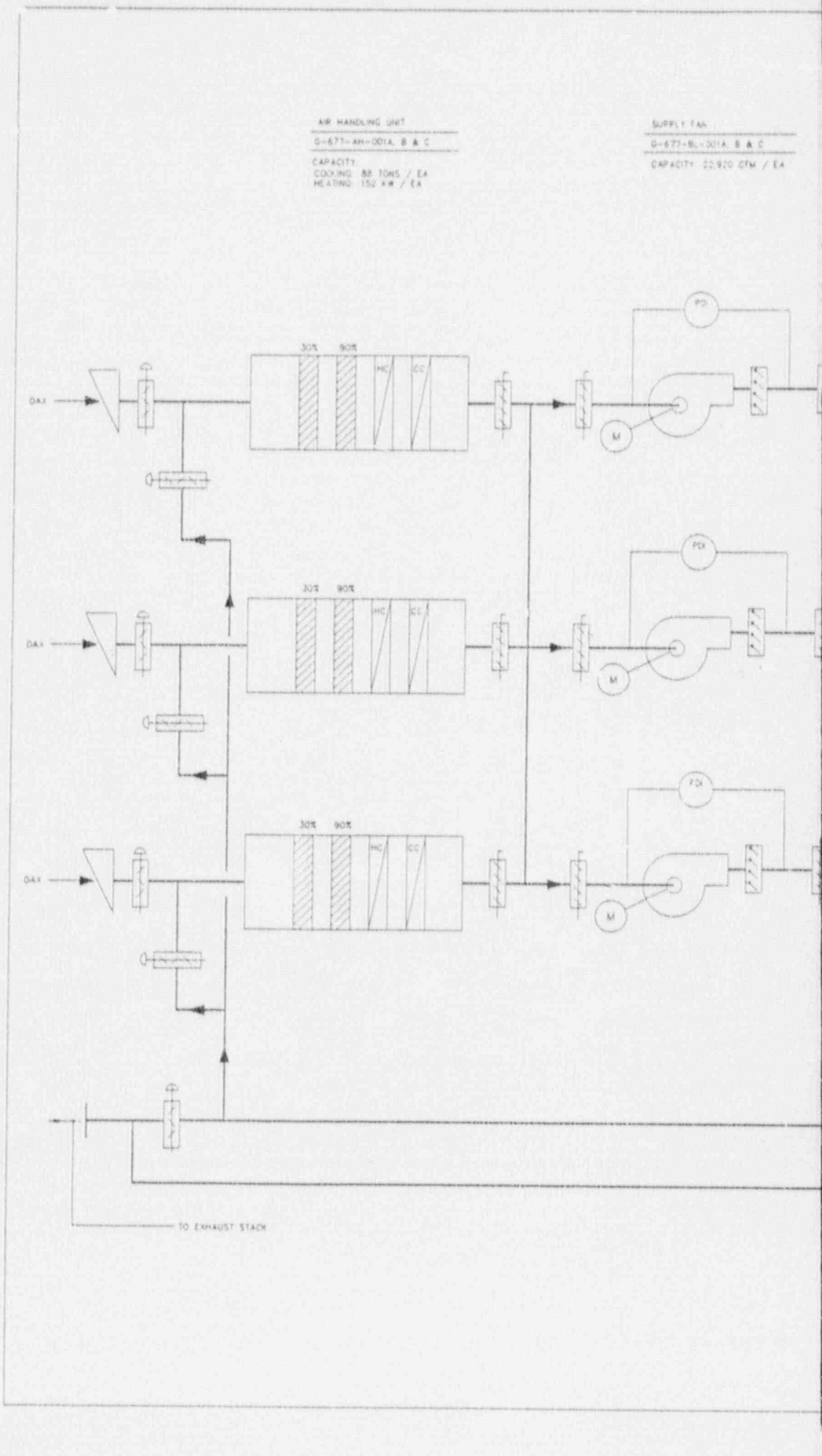
FLUOR DANIEL

LOUISIANA ENERGY

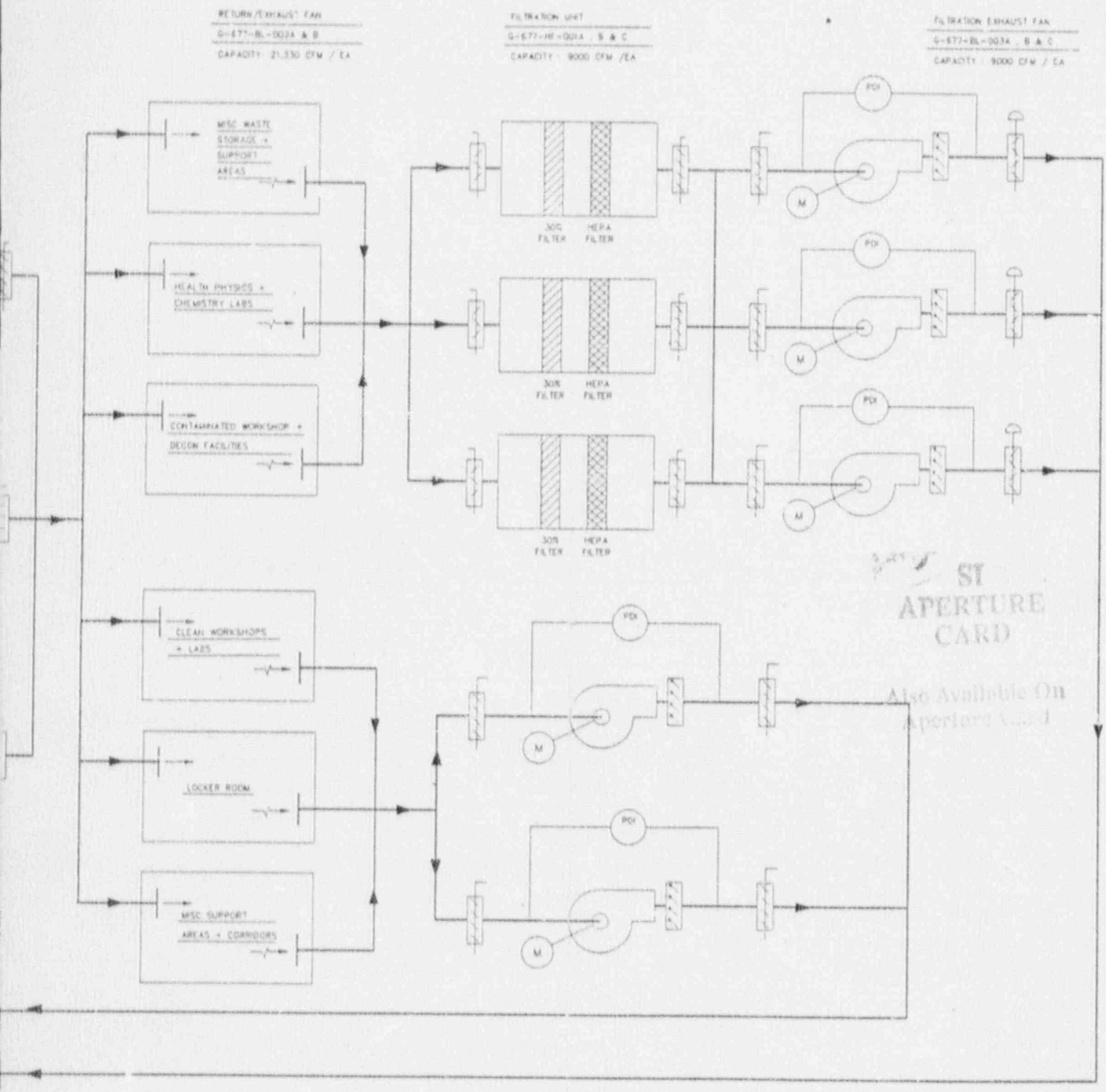
CLAIBORNE ENRICHMENT CENTER

SEPARATIONS BUILDING
VENTILATION ZONES
EL. 115'-6"

Figure 3.3-2



AIR HANDLING UNIT
G-677-AH-001A, B & C
CAPACITY:
COOLING: 88 TONS / EA
HEATING: 152 KW / EA
SUPPLY FAN
G-677-BL-001A, B & C
CAPACITY: 22,920 CFM / EA
30%
90%
HC
CC
OAX
PDI
M
TO EXHAUST STACK



DWG. NO. G-677-0370 REV.01A | SHEET 1 OF 1

FLUOR DANIEL

LOUISIANA ENERGY

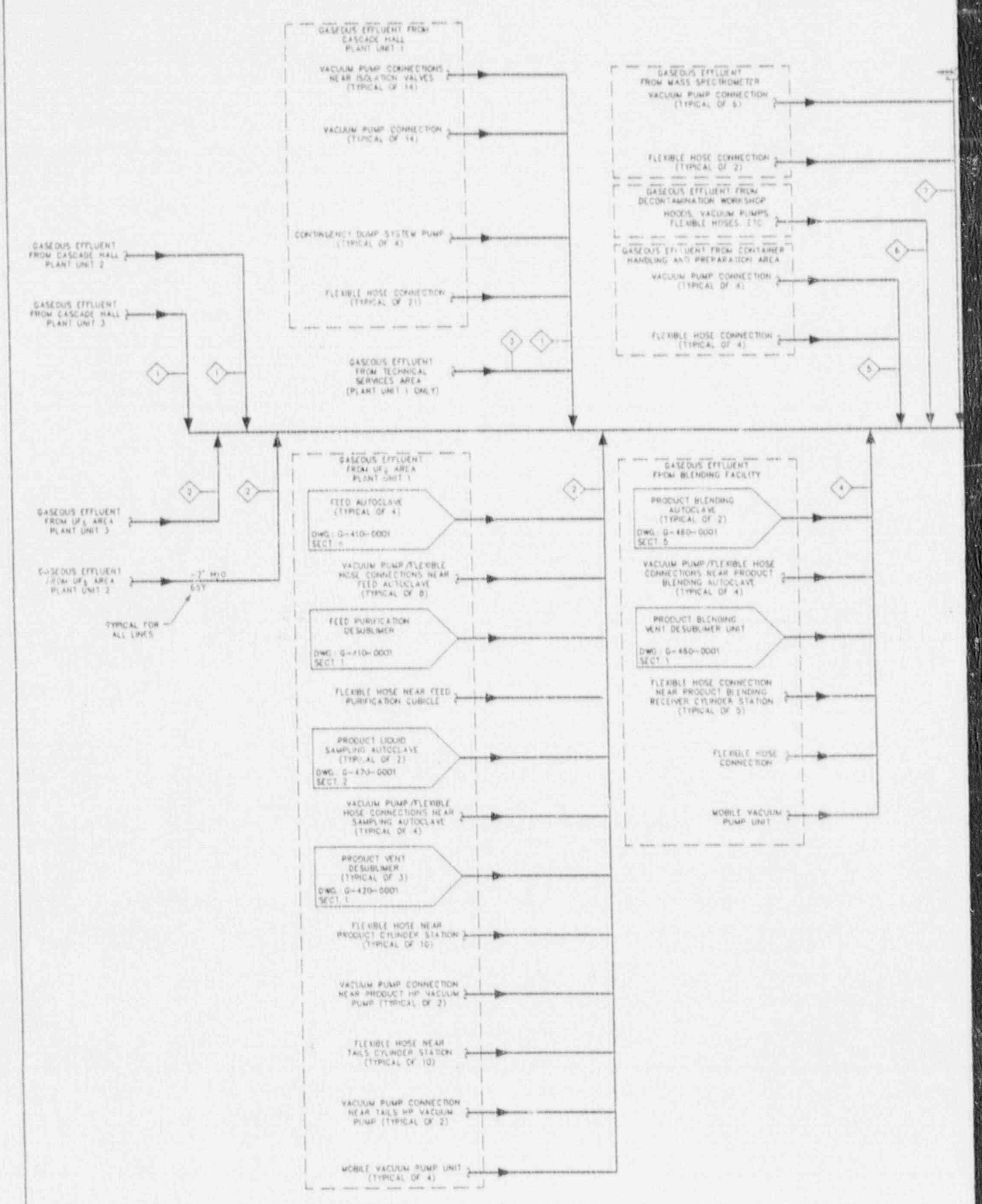
CLAIBORNE ENRICHMENT CENTER

FLOW DIAGRAM
TECHNICAL SERVICES AREA
HVAC SYSTEM

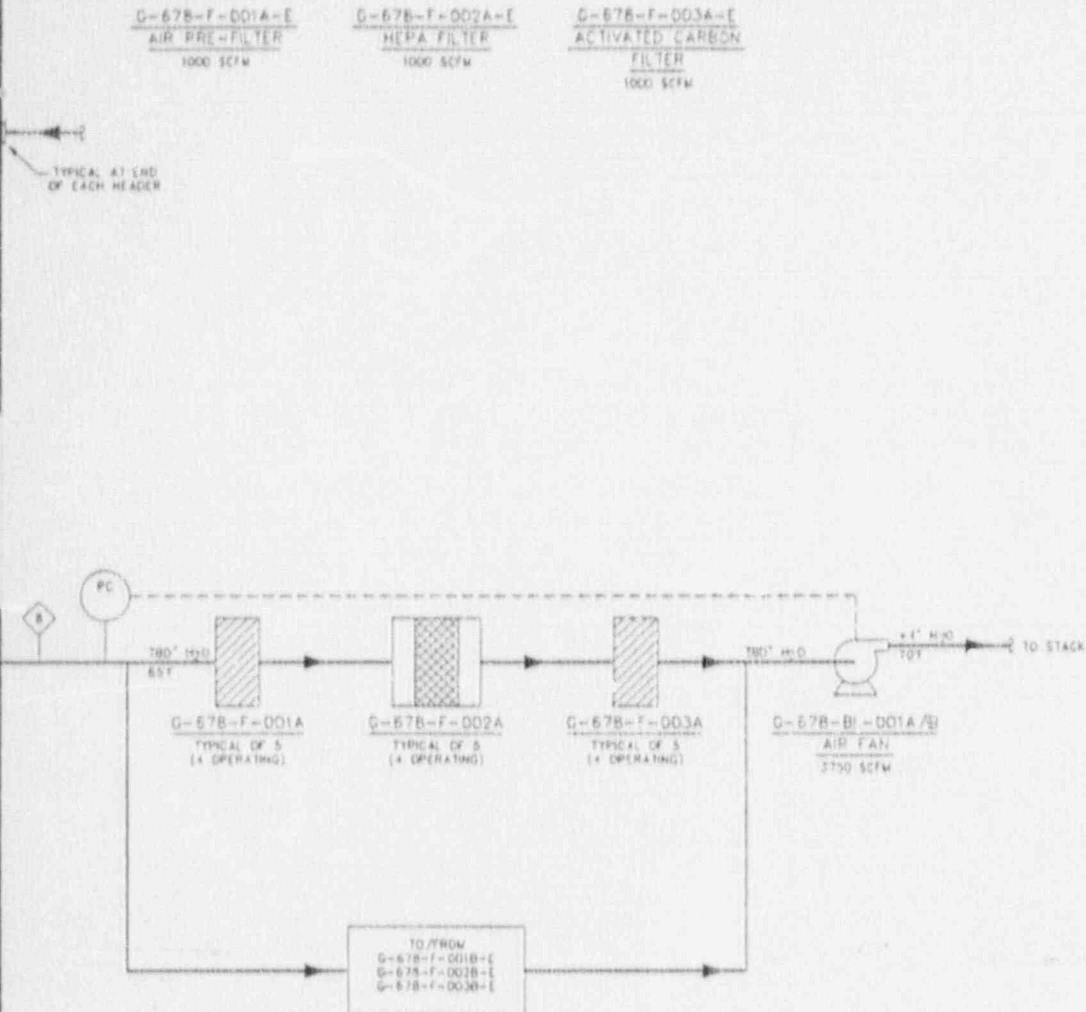
Figure 3.3-3

ACAD DF=ER333

9102060114-34



STREAM NUMBER	1	2	3	4	5	6	7	8
DESCRIPTION	CASCADE HALL EFFLUENT	UF_6 AREA EFFLUENT	EFFLUENT FROM TECHNICAL SERVICES EQUIPMENT	BLENDING FACILITY EFFLUENT	CONTAINER AREA EFFLUENT	DECONTAMINATION WORKSHOP EFFLUENT	MASS SPECTROMETER EFFLUENT	PLANT GASEOUS EFFLUENT
AIR (SCFM) MAX OPERATING	250	500	50	200	110	1250	110	3750



SI
APERTURE
CARD

NOTES:

1. FLOWRATES SHOWN REPRESENT MAXIMUM OPERATING RATES. GASEOUS EFFLUENT STREAMS DO NOT ALL OPERATE SIMULTANEOUSLY. CONSEQUENTLY THE NORMAL PLANT EFFLUENT RATE IS LESS THAN THE SUM OF THE COMPONENT STREAMS.

2. ALL TEMPERATURES, PRESSURES, AND FLOWS FOR PROCESS DESIGN PURPOSES ONLY. NO GUARANTEE OF THESE CONDITIONS IS EXPRESSED OR IMPLIED. SUPPLEMENTARY DESIGN INFORMATION IS CONTAINED IN THE SYSTEM DESIGN BASIS, SDB-678.

DWG. NO. G-678-0001	REV. 1	SHEET 1 OF 1

FLUOR DANIEL

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

FLOW DIAGRAM

GASEOUS EFFLUENT VENT SYSTEM

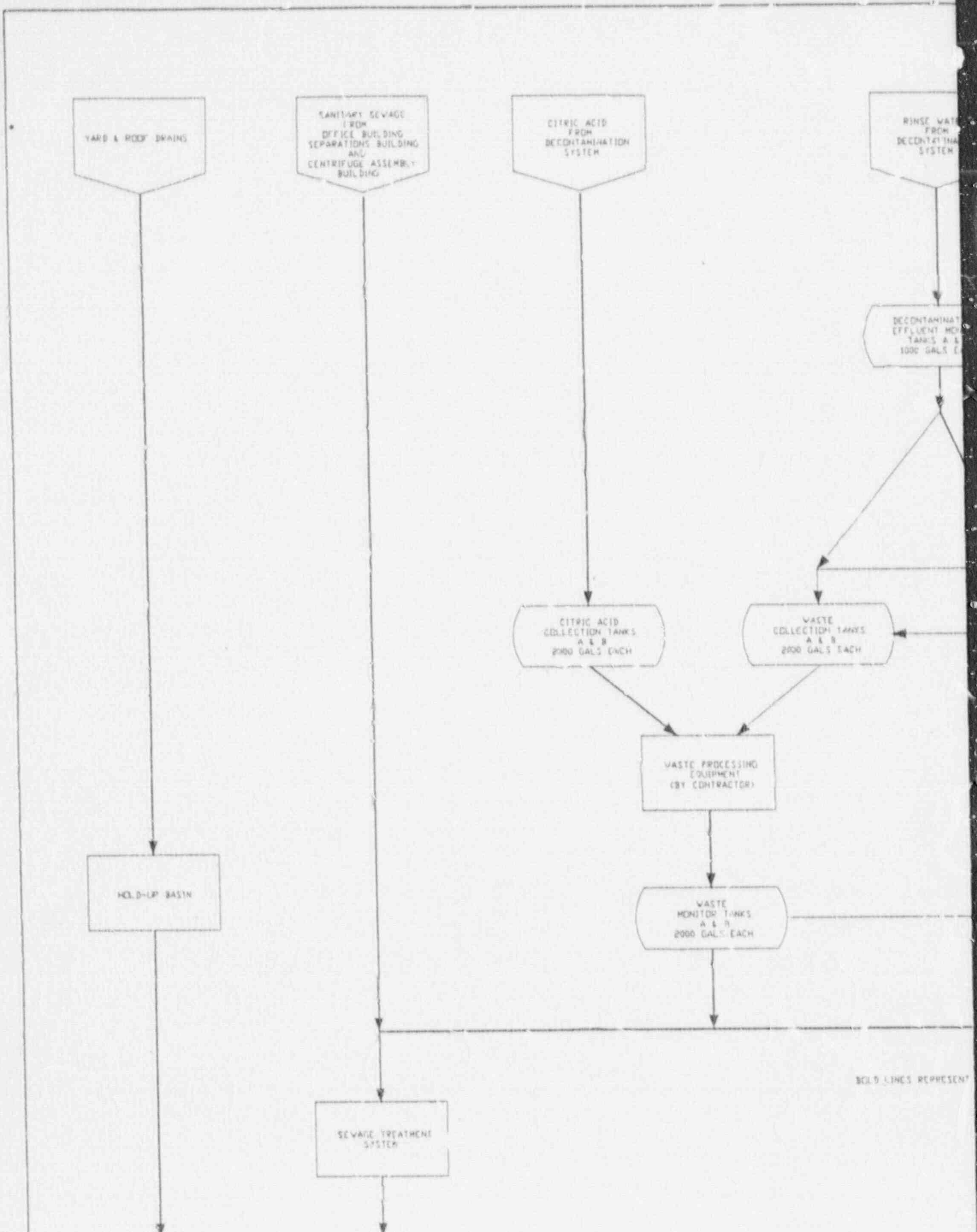
Figure 3.3-4

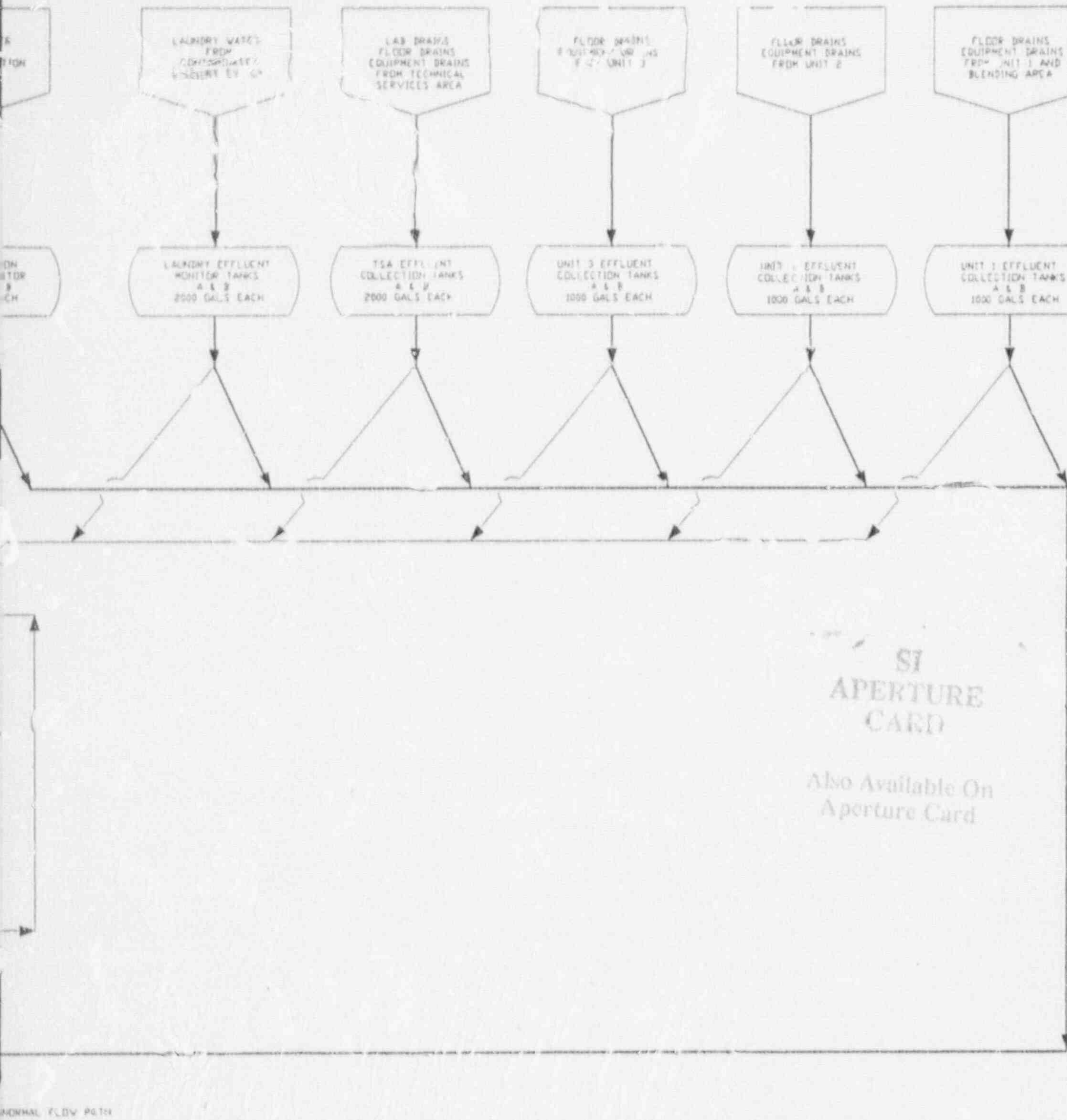
9102060114 - 35

2

1

ACAD DFK-ER33

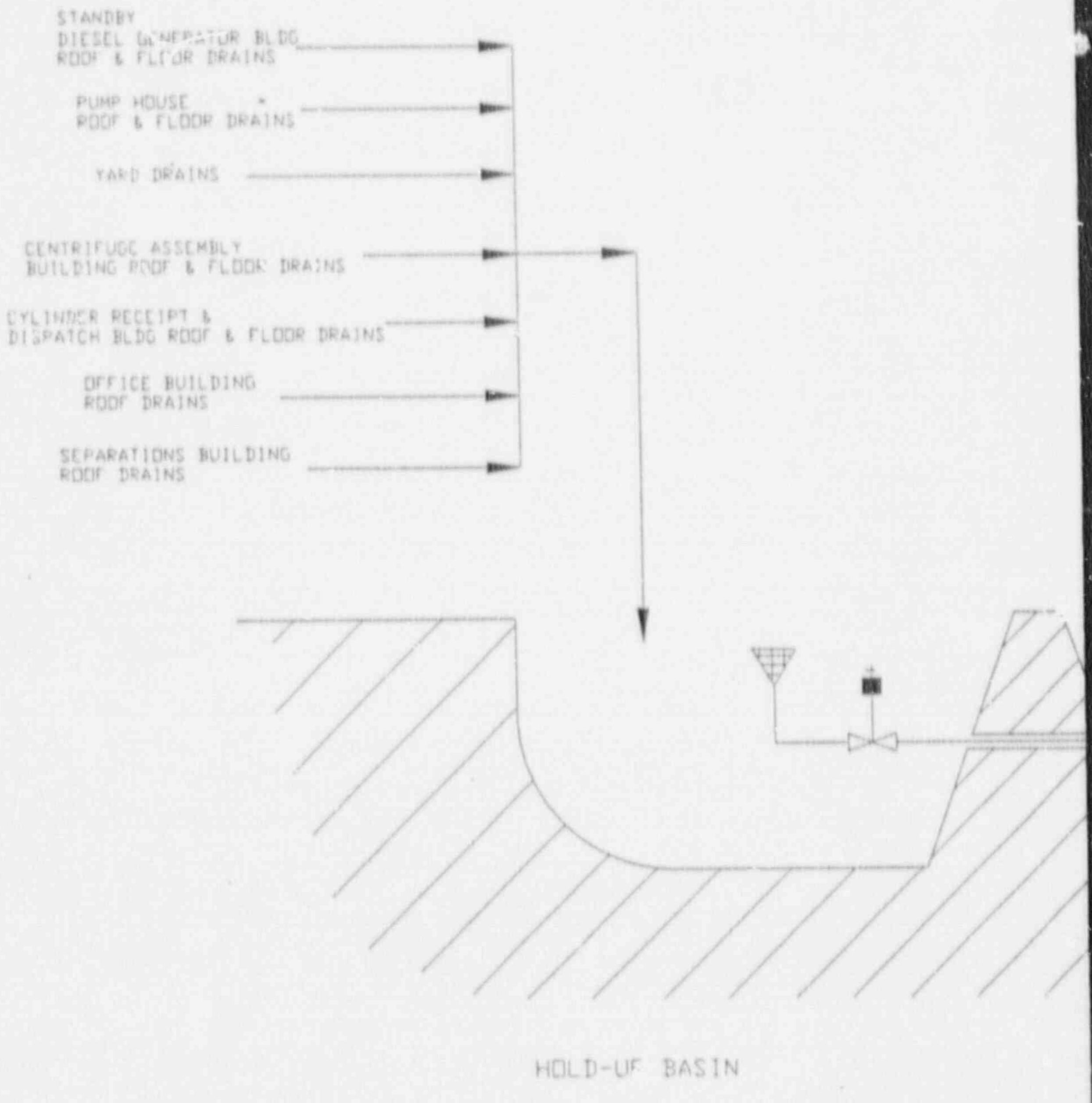

YARD & ROOF DRAINS
SANITARY SEWAGE FROM OFFICE BUILDING SEPARATIONS BUILDING AND CENTRIFUGE ASSEMBLY BUILDING
CITRIC ACID FROM DECONTAMINATION SYSTEM
RINSE WATE FROM DECONTAMINA SYSTEM
DECONTAMINAT EFFLUENT MON TANKS A & 1000 GALS EA
CITRIC ACID COLLECTION TANKS A & B 2000 GALS EACH
WASTE COLLECTION TANKS A & B 2000 GALS EACH
WASTE PROCESSING EQUIPMENT (BY CONTRACTOR)
WASTE MONITOR TANKS A & B 2000 GALS EACH
HOLD-UP BASIN
SEWAGE TREATMENT SYSTEM
BOLD LINES REPRESENT
TO ENVIRONMENT (BLUEGILL POND)
TO ENVIRONMENT (BLUEGILL POND)

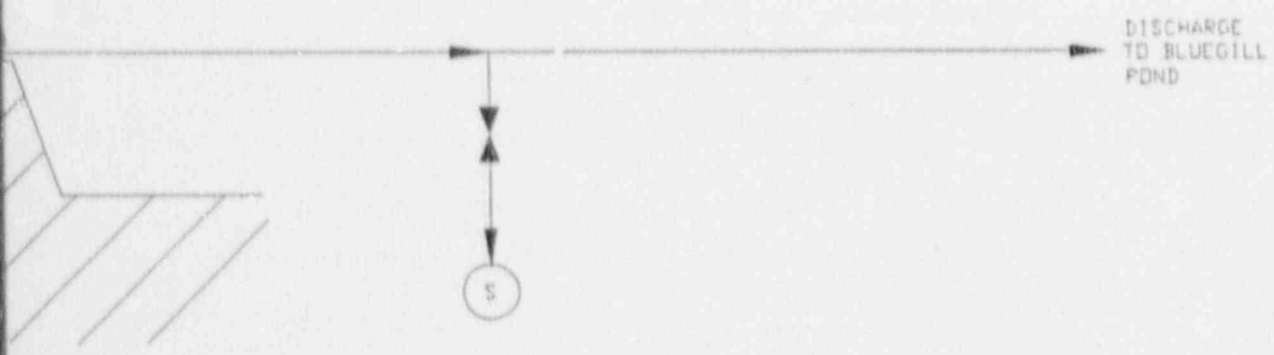


LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

COMBINED DIAGRAM
OF AQUEOUS LIQUID EFFLUENT SYSTEMS

Figure 3.3-5


STANDBY
DIESEL GENERATOR BLDG
ROOF & FLOOR DRAINS
PUMP HOUSE
ROOF & FLOOR DRAINS
YARD DRAINS
CENTRIFUGE ASSEMBLY
BUILDING ROOF & FLOOR DRAINS
CYLINDER RECEIPT &
DISPATCH BLDG ROOF & FLOOR DRAINS
OFFICE BUILDING
ROOF DRAINS
SEPARATIONS BUILDING
ROOF DRAINS
HOLD-UP BASIN



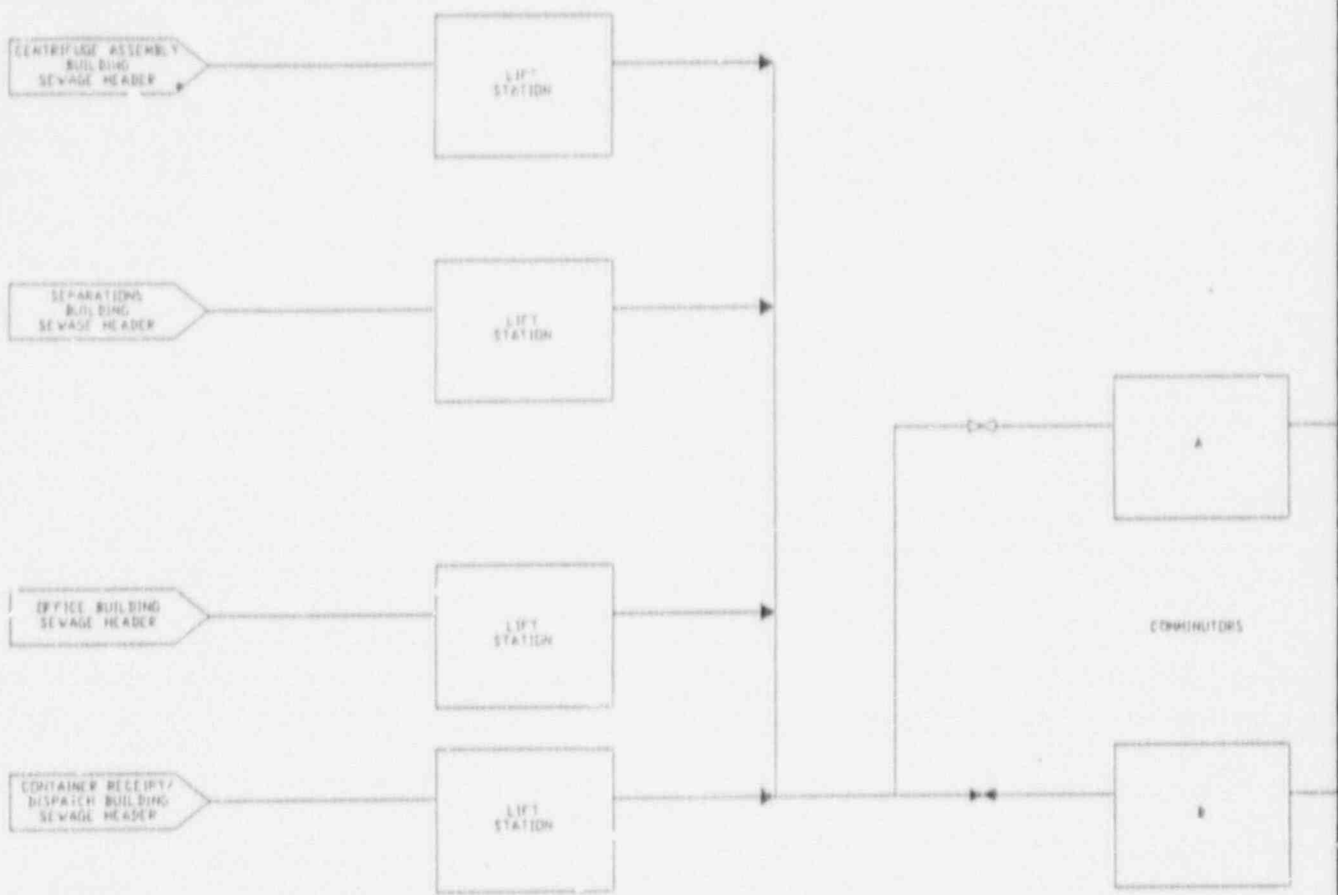
DWG. NO. 1702.12-0001 REV. 1	SHEET 1 OF 1

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

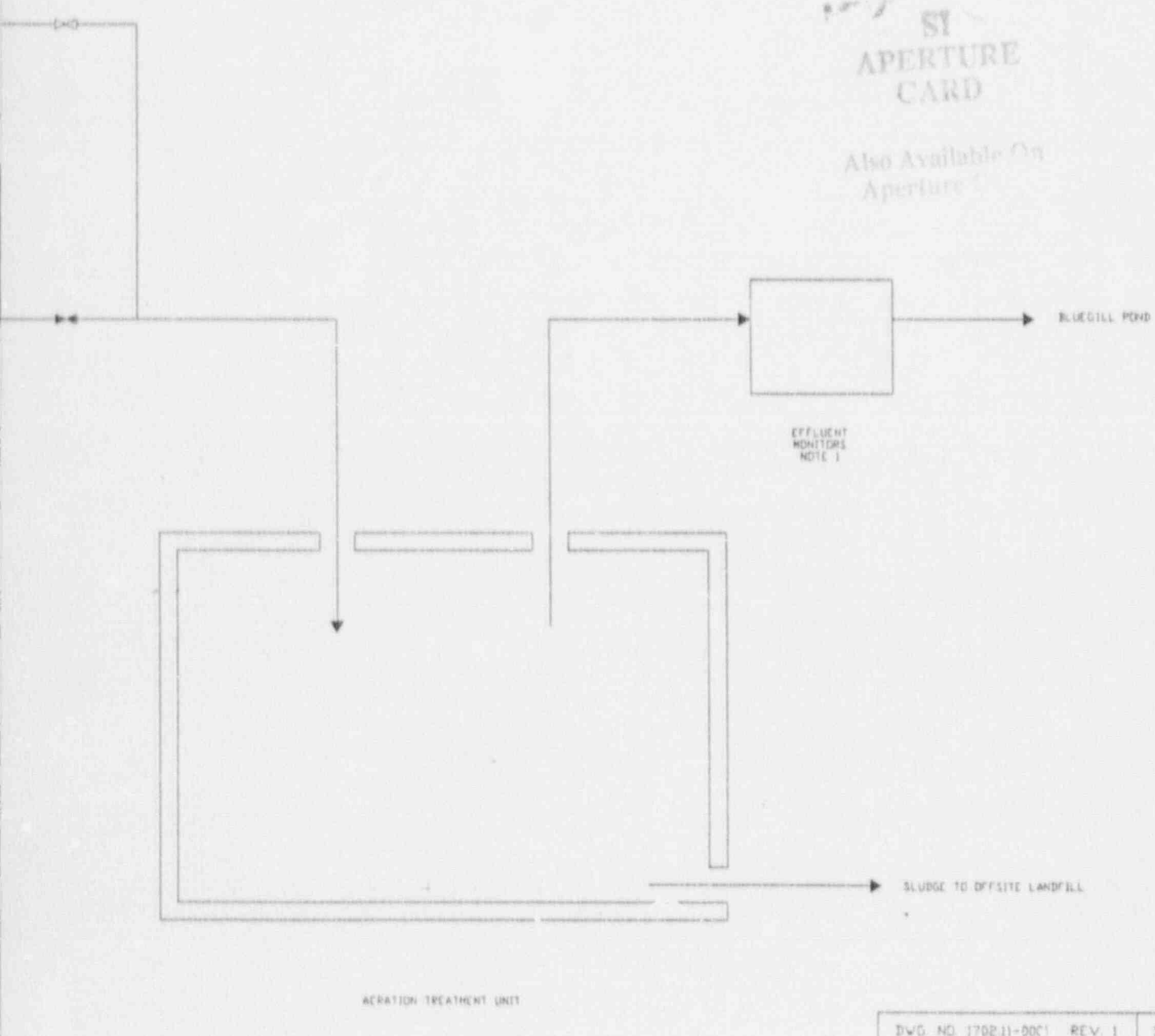
FLOW DIAGRAM
YARD DRAIN SYSTEM

Figure 3.3-6

9102060114-37


CENTRIFUGE ASSEMBLY BUILDING SEWAGE HEADER
LIFT STATION
SEPARATIONS BUILDING SEWAGE HEADER
LIFT STATION
OFFICE BUILDING SEWAGE HEADER
LIFT STATION
CONTAINER RECEIPT/ DISPATCH BUILDING SEWAGE HEADER
LIFT STATION
A
COMMINUTORS
B

1. ITEMS MONITORED ARE:
- pH
- TURBIDITY
- DISSOLVED OXYGEN
- TOTAL DISSOLVED SOLIDS
- FECAL COLIFORM
- TOTAL FLOW
- TEMPERATURE



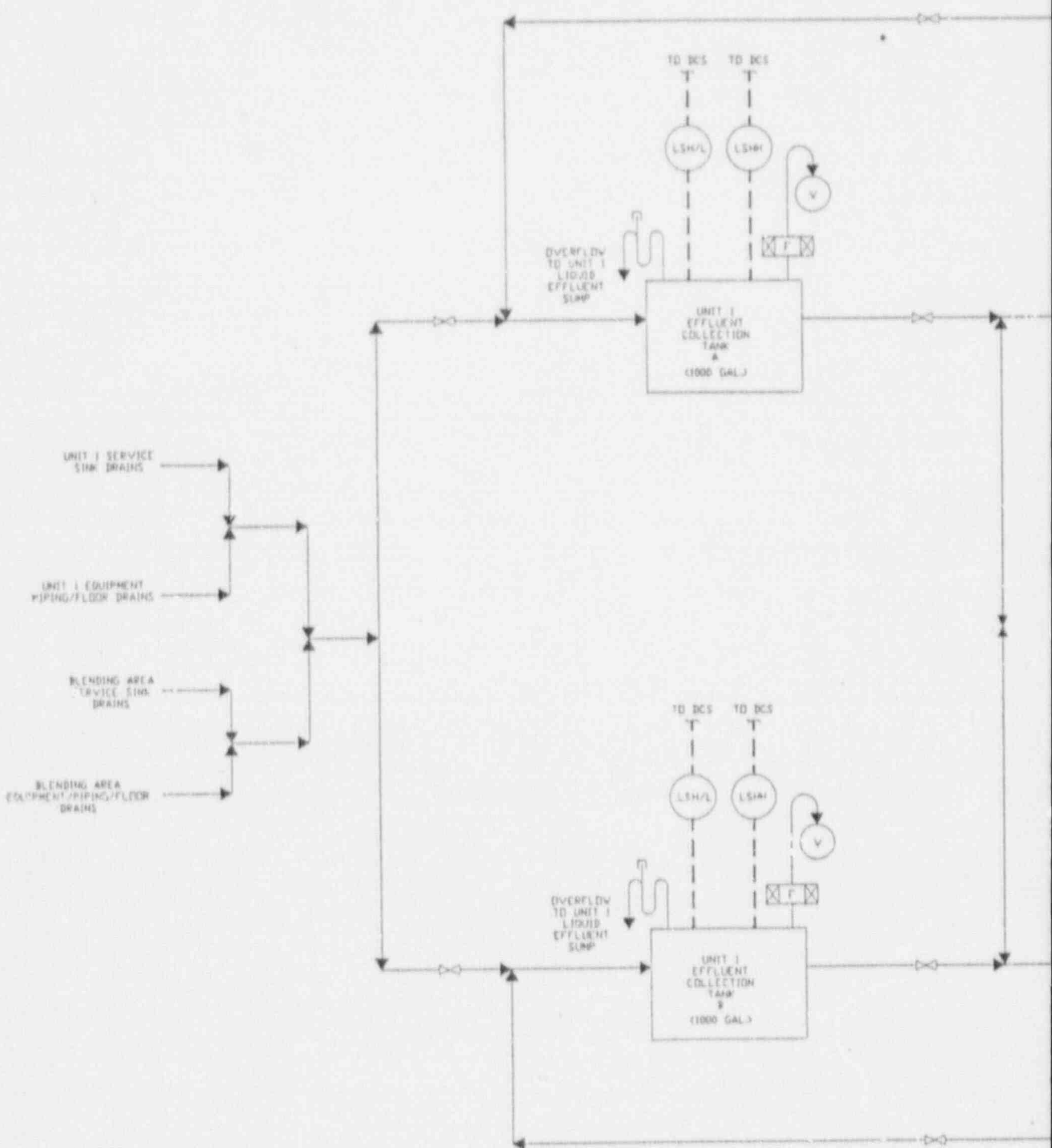
DWG. NO. 170211-0001	REV. 1	SHEET 1 OF 1

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

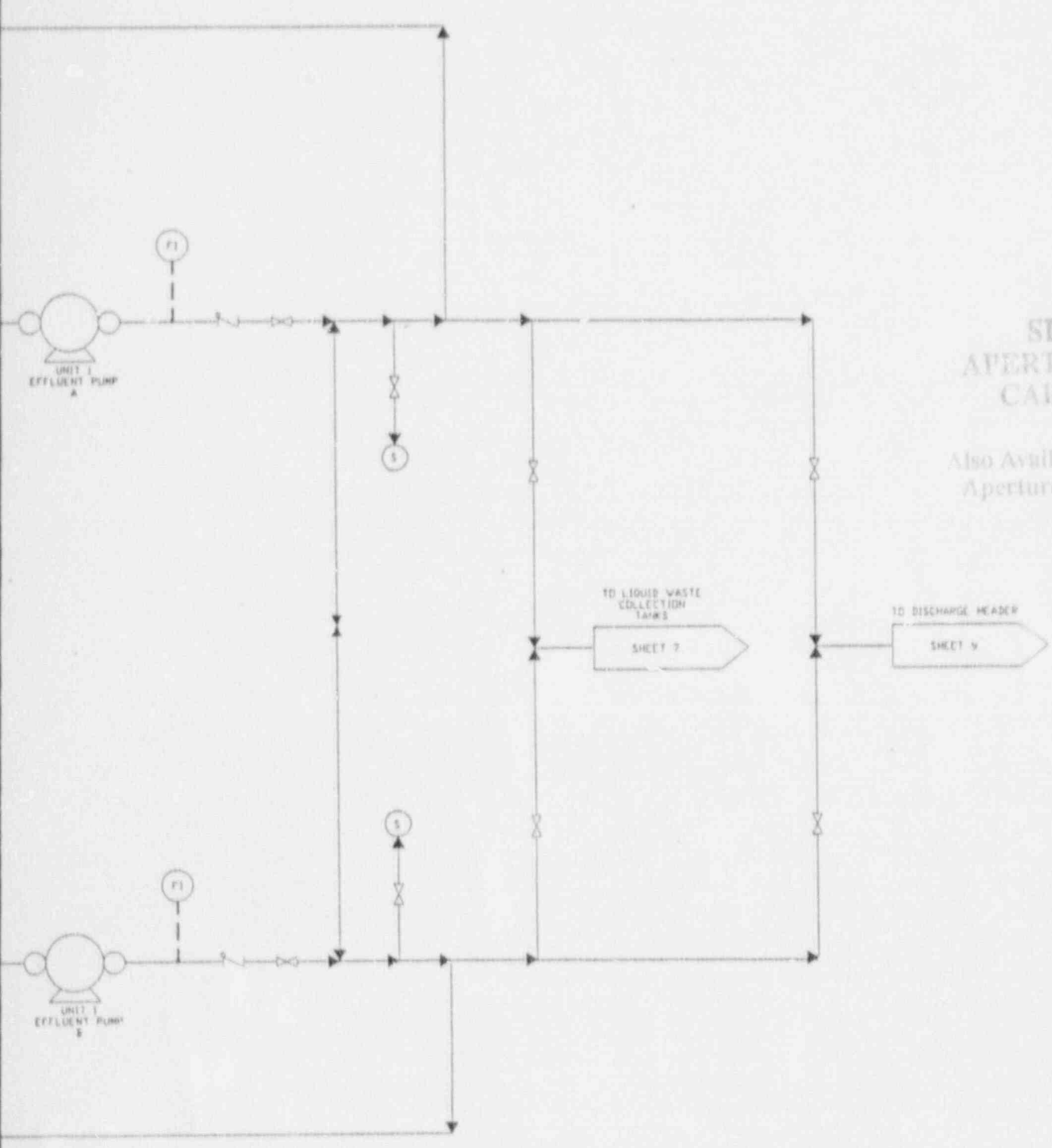
FLOW DIAGRAM
SEWAGE TREATMENT SYSTEM

Figure 3.3-7

2 1 1


TO DCS
TO DCS
LSH/L
LSHH
V
F
OVERFLOW TO UNIT 1 LIQUID EFFLUENT SUMP
UNIT 1 EFFLUENT COLLECTION TANK A (1000 GAL.)
UNIT 1 SERVICE SINK DRAINS
UNIT 1 EQUIPMENT PIPING/FLOOR DRAINS
BLENDING AREA SERVICE SINK DRAINS
BLENDING AREA EQUIPMENT/PIPING/FLOOR DRAINS
TO DCS
TO DCS
LSH/L
LSHH
V
F
OVERFLOW TO UNIT 1 LIQUID EFFLUENT SUMP
UNIT 1 EFFLUENT COLLECTION TANK B (1000 GAL.)

3

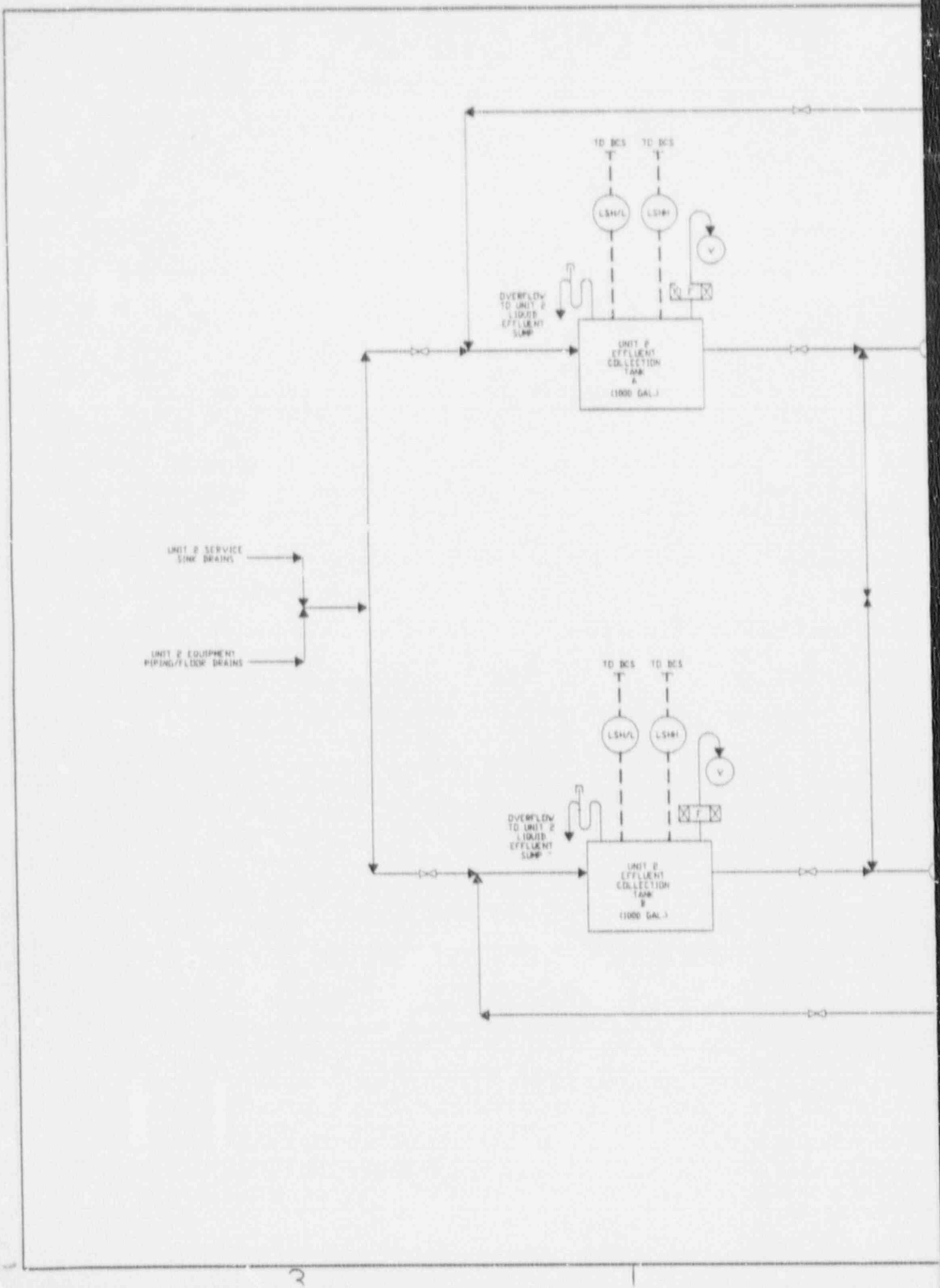


SHEET 1 OF 9

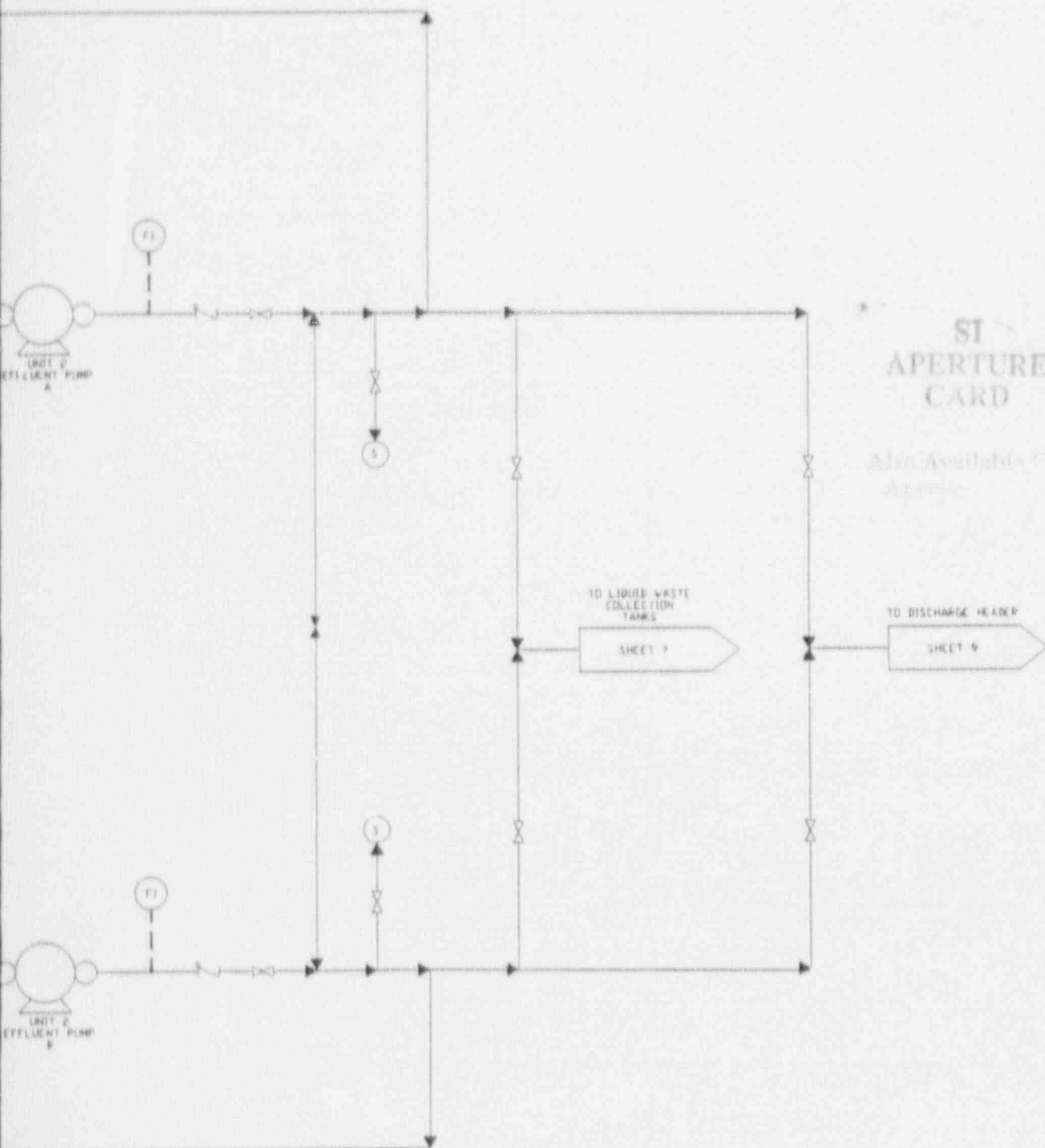
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

FLOW DIAGRAM
AQUEOUS LIQUID WASTE COLLECTION AND DISPOSAL (UNIT 1 EFFLUENT)

Figure 3.3-8



TO DCS
TO DCS
LSH/L
LSHH
V
OVERFLOW TO UNIT 2 LIQUID EFFLUENT SUMP
UNIT 2 EFFLUENT COLLECTION TANK A (1000 GAL.)
UNIT 2 SERVICE SINK DRAINS
UNIT 2 EQUIPMENT PIPING/FLOOR DRAINS
TO DCS
TO DCS
LSH/L
LSHH
V
OVERFLOW TO UNIT 2 LIQUID EFFLUENT SUMP
UNIT 2 EFFLUENT COLLECTION TANK B (1000 GAL.)

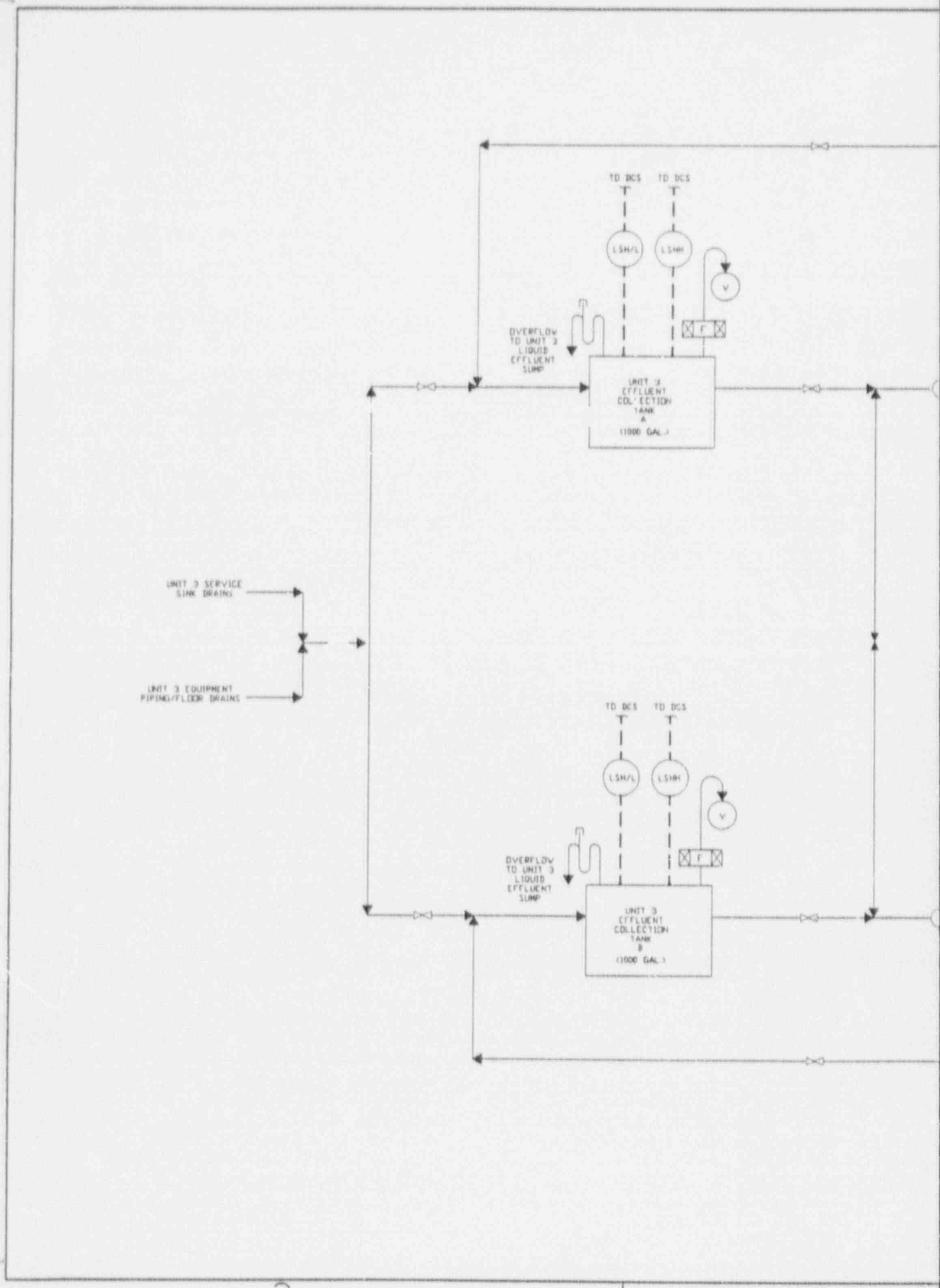


SHEET 2 OF 9

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

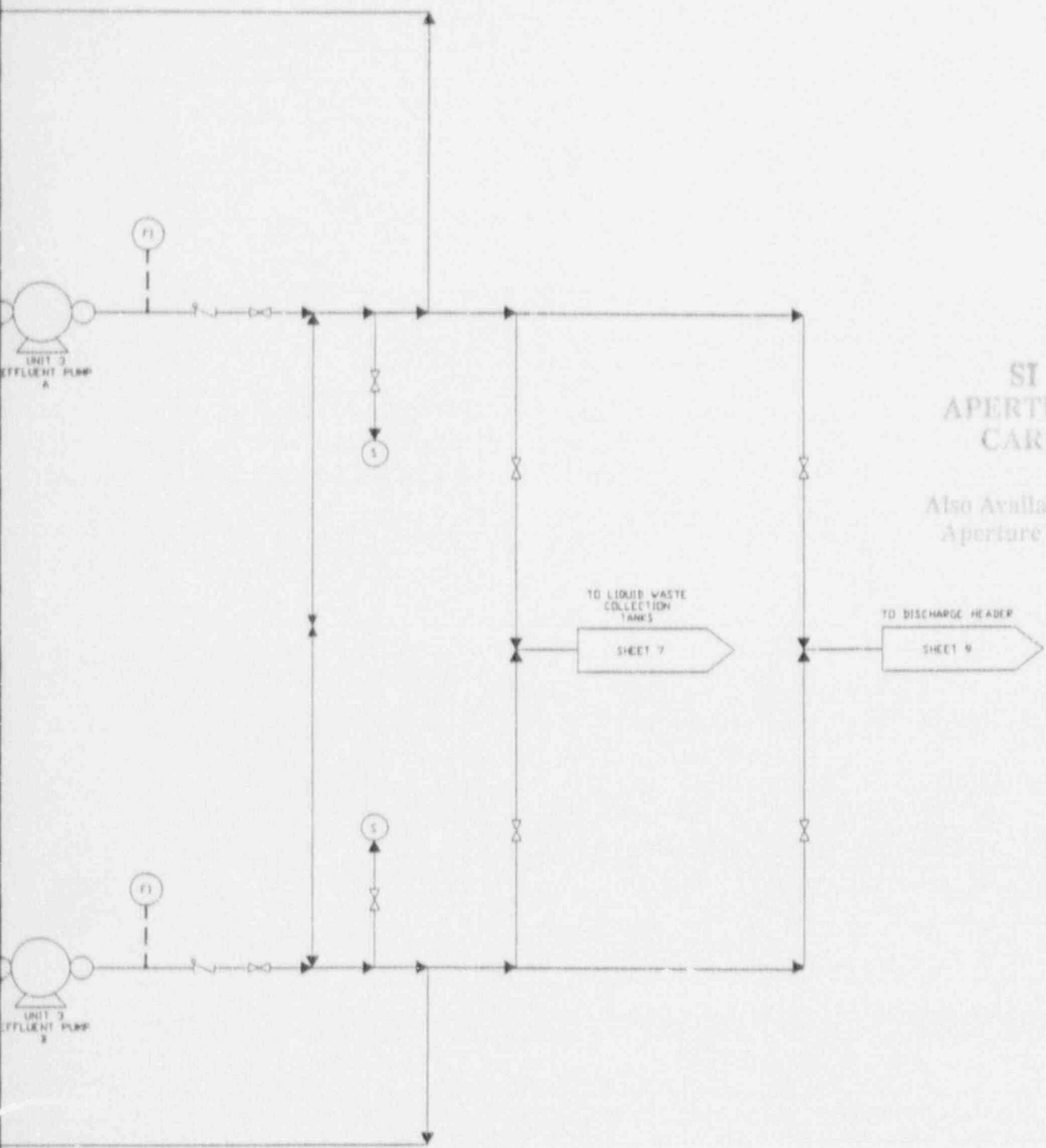
FLOW DIAGRAM
AQUEOUS LIQUID WASTE COLLECTION AND DISPOSAL (UNIT 2 EFFLUENT)

Figure 3.3-8



TO DCS
TO DCS
LSH/L
LSHH
V
F
OVERFLOW TO UNIT 3 LIQUID EFFLUENT SUMP
UNIT 3 EFFLUENT COLLECTION TANK A (1000 GAL.)
UNIT 3 SERVICE SINK DRAINS
UNIT 3 EQUIPMENT PIPING/FLOOR DRAINS
TO DCS
TO DCS
LSH/L
LSHH
V
F
OVERFLOW TO UNIT 3 LIQUID EFFLUENT SUMP
UNIT 3 EFFLUENT COLLECTION TANK B (1000 GAL.)

3

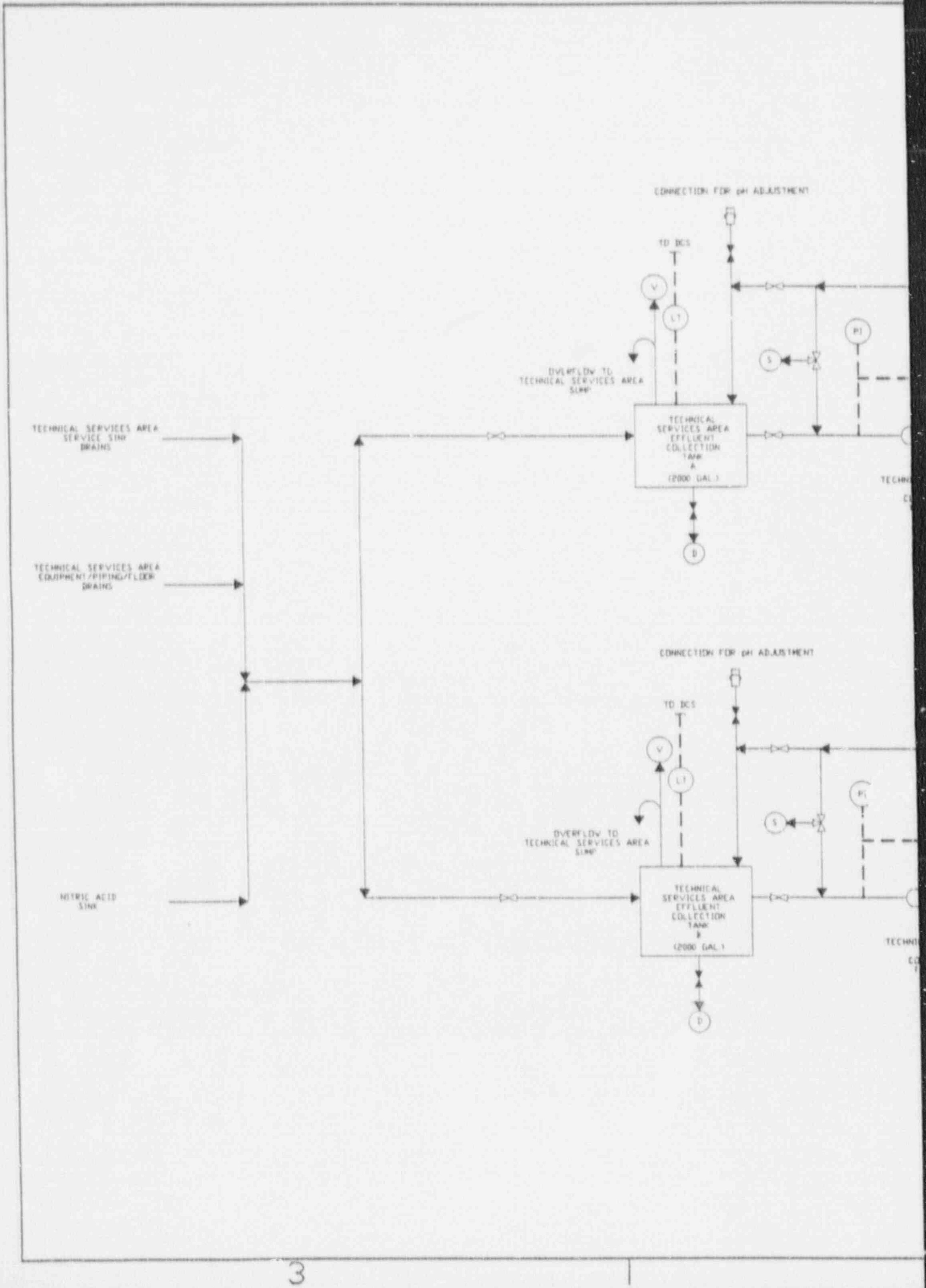


SHEET 3 OF 9

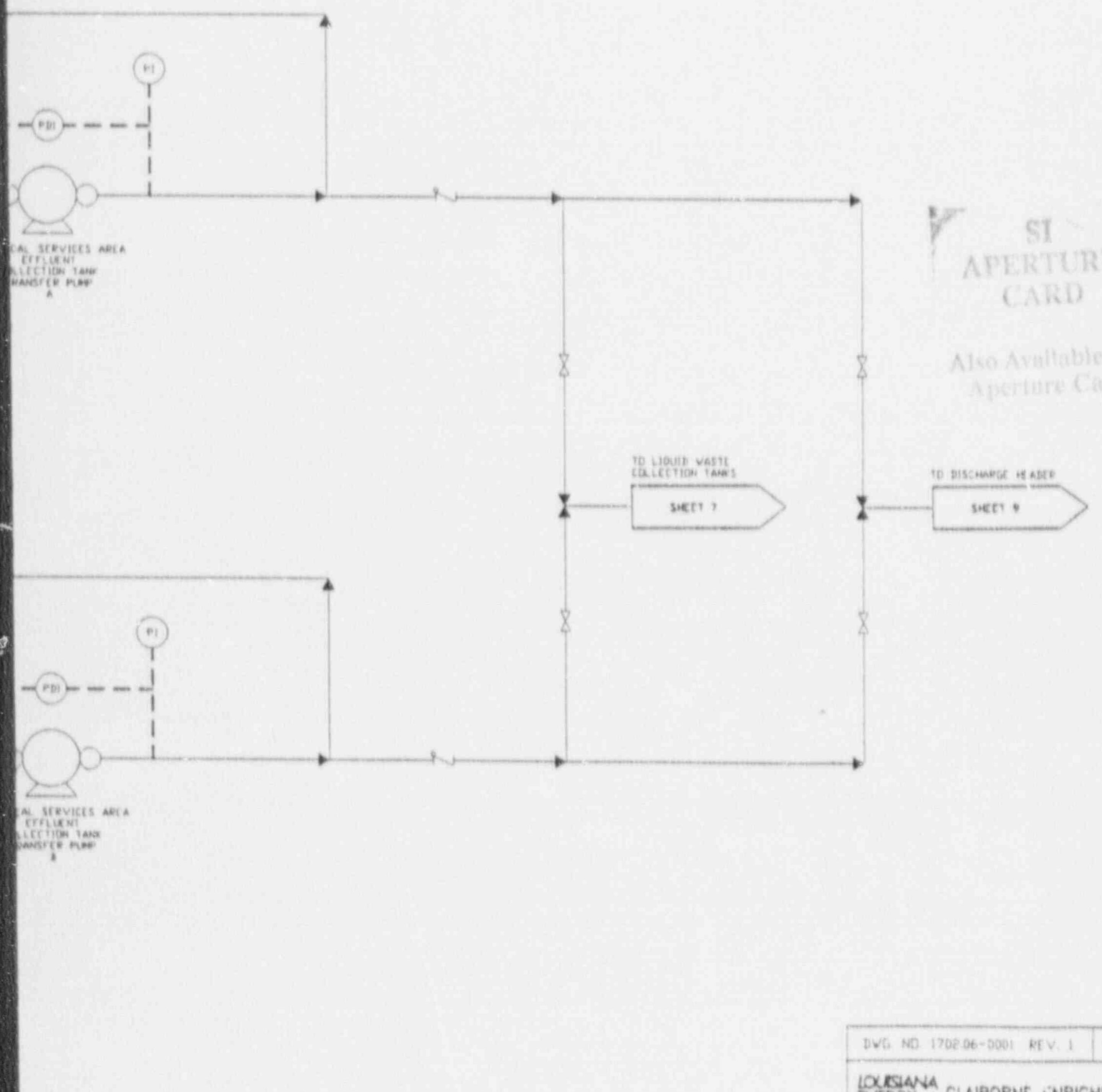
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

FLOW DIAGRAM
AQUEOUS LIQUID WASTE COLLECTION
AND DISPOSAL (UNIT 3 EFFLUENT)

Figure 3.3-8



CONNECTION FOR pH ADJUSTMENT
TO DCS
OVERFLOW TO TECHNICAL SERVICES AREA SUMP
TECHNICAL SERVICES AREA SERVICE SINK DRAINS
TECHNICAL SERVICES AREA EFFLUENT COLLECTION TANK A (2000 GAL.)
TECHNICAL SERVICES AREA EQUIPMENT/PIPING/FLOOR DRAINS
CONNECTION FOR pH ADJUSTMENT
TO DCS
OVERFLOW TO TECHNICAL SERVICES AREA SUMP
NITRIC ACID SINK
TECHNICAL SERVICES AREA EFFLUENT COLLECTION TANK B (2000 GAL.)
3



DWG. NO. 1702.06-0001 REV. 1	SHEET 4 OF 9

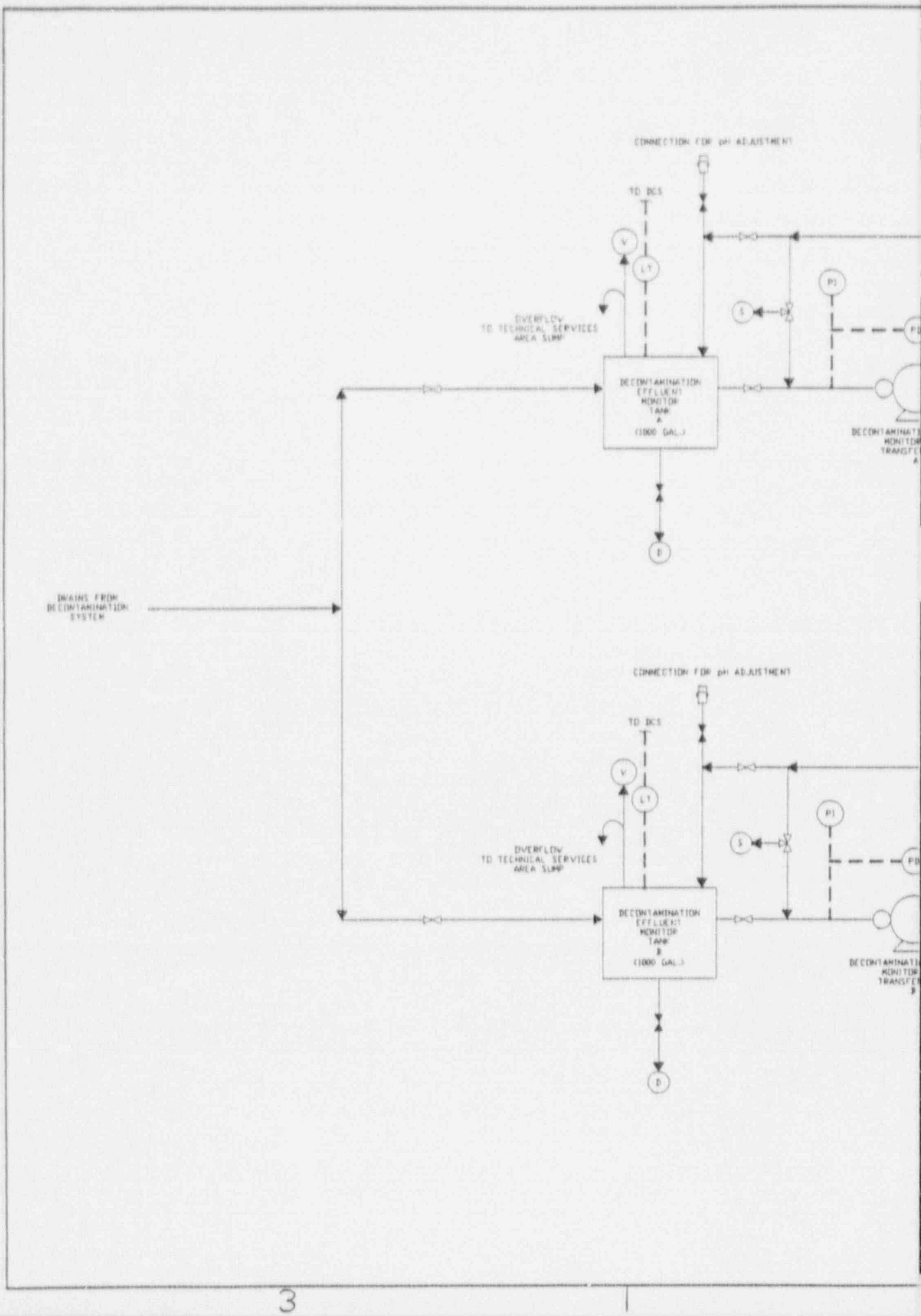
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

FLOW DIAGRAM
AQUEOUS LIQUID WASTE COLLECTION
AND DISPOSAL (TSA EFFLUENT)

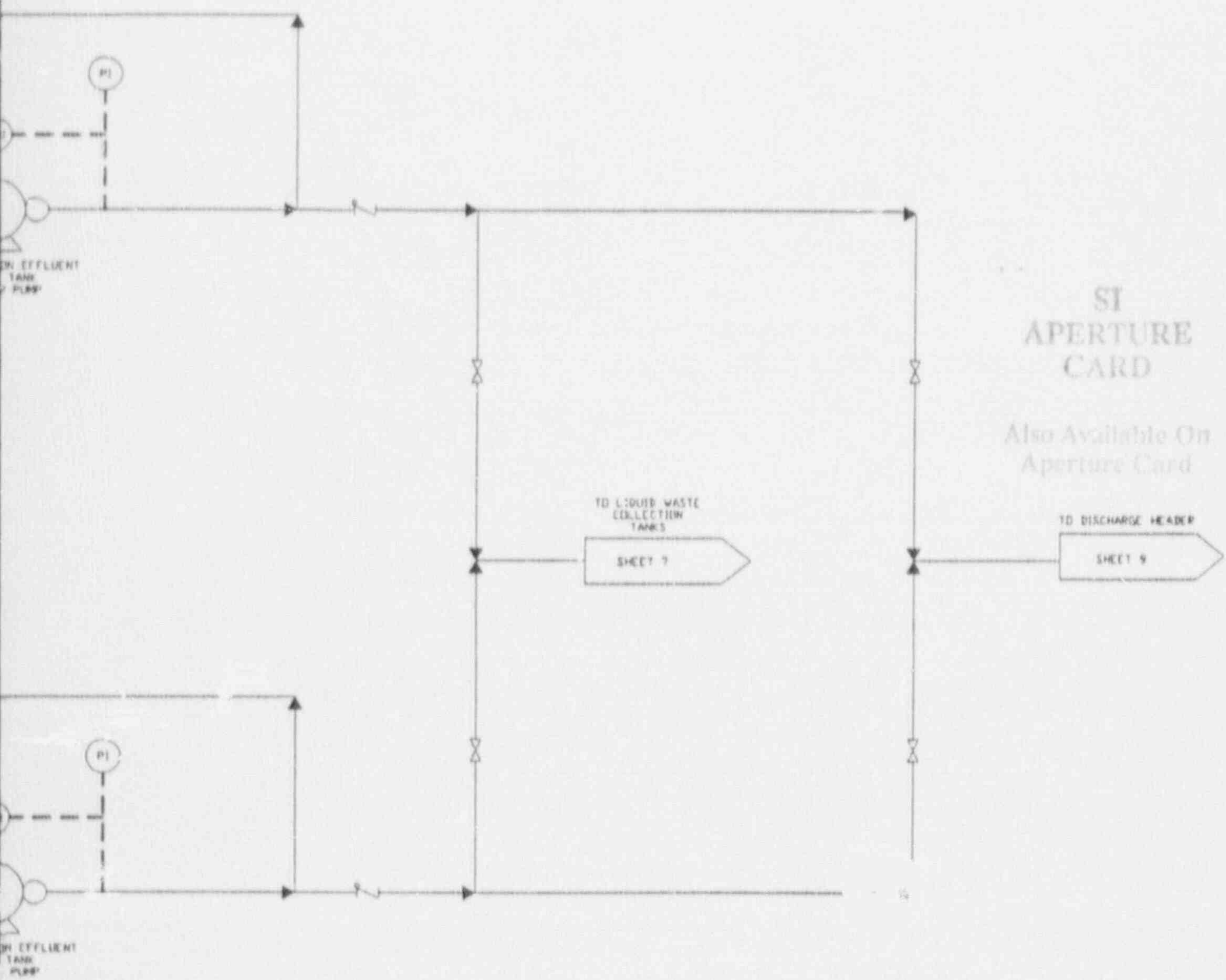
Figure 3.3-8

9102060114-42

2 1


CONNECTION FOR pH ADJUSTMENT
TO DCS
V
LT
PI
S
OVERFLOW
TO TECHNICAL SERVICES
AREA SUMP
DECONTAMINATION
EFFLUENT
MONITOR
TANK
A
(1000 GAL.)
D
DRAINS FROM
DECONTAMINATION
SYSTEM
CONNECTION FOR pH ADJUSTMENT
TO DCS
V
LT
PI
S
OVERFLOW
TO TECHNICAL SERVICES
AREA SUMP
DECONTAMINATION
EFFLUENT
MONITOR
TANK
B
(1000 GAL.)
D

3



DWG. NO. 1702.06-0002 REV. 1 | SHEET 5 OF 9

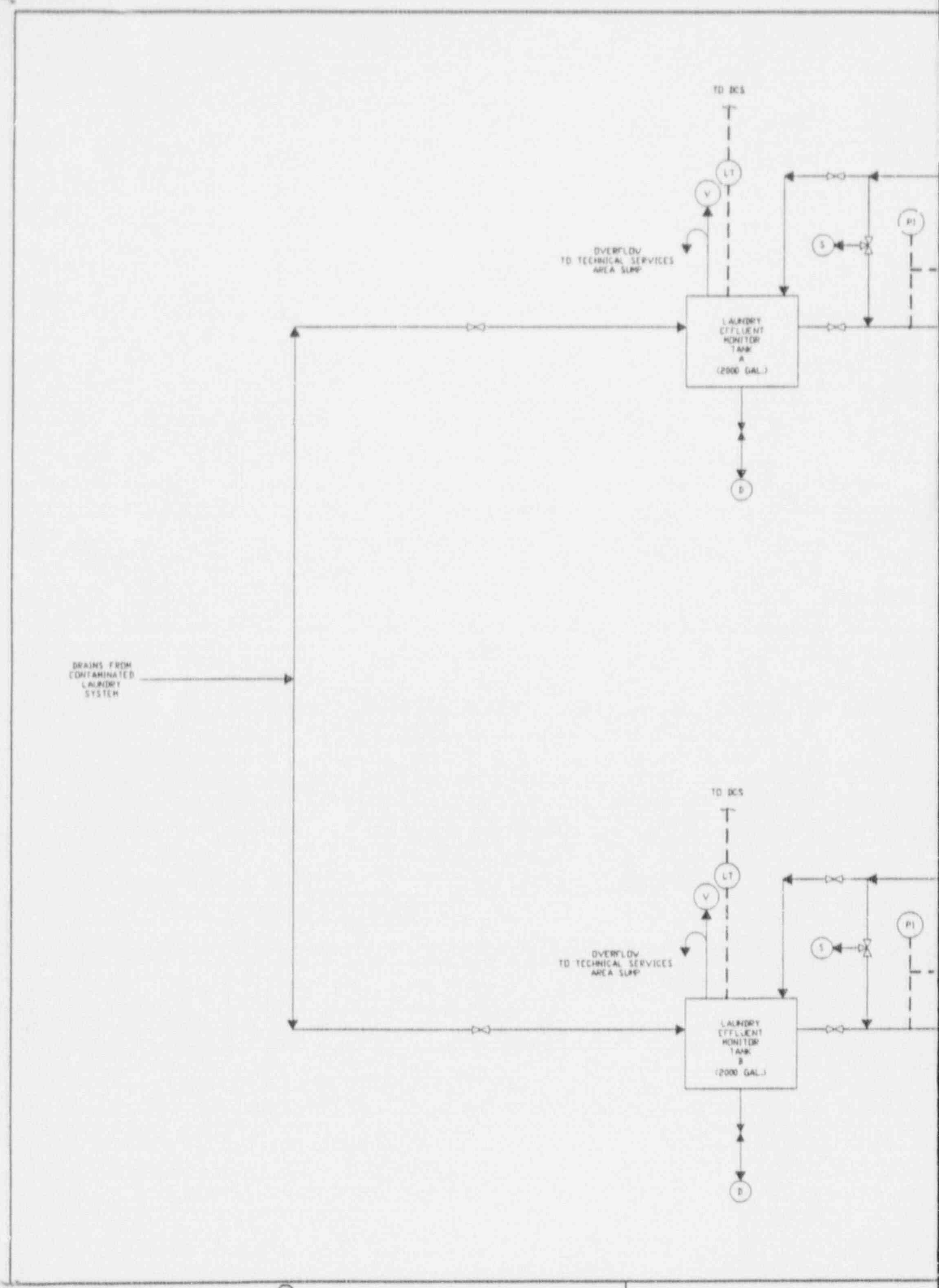
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

FLOW DIAGRAM AQUEOUS LIQUID WASTE COLLECTION AND DISPOSAL (DECON EFFLUENT)

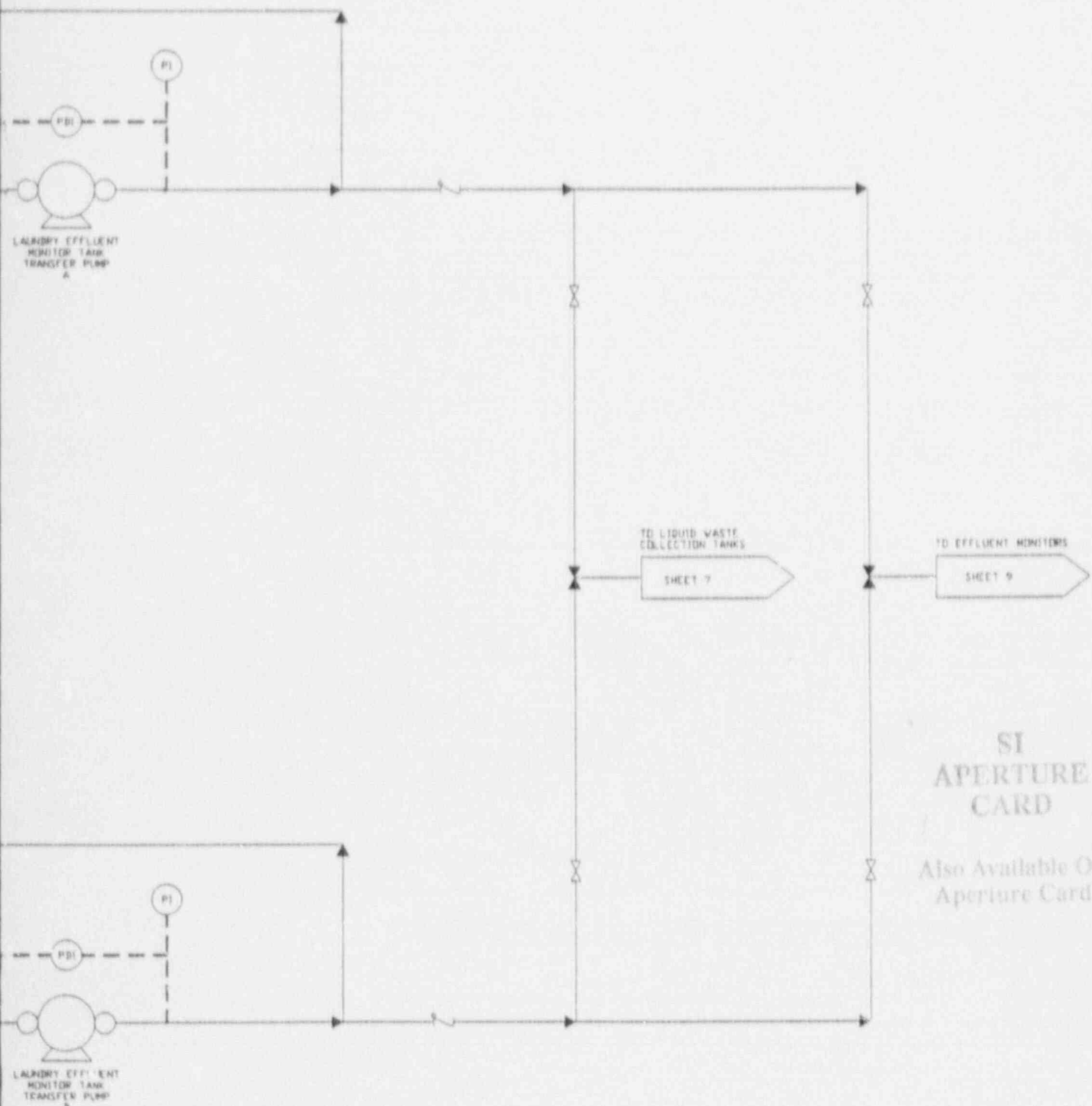
Figure 3.3-8

 4-43

2 1 1



TO DCS
LT
V
PI
S
OVERFLOW
TO TECHNICAL SERVICES
AREA SUMP
LAUNDRY
EFFLUENT
MONITOR
TANK
A
(2000 GAL.)
D
DRAINS FROM
CONTAMINATED
LAUNDRY
SYSTEM
TO DCS
LT
V
PI
S
OVERFLOW
TO TECHNICAL SERVICES
AREA SUMP
LAUNDRY
EFFLUENT
MONITOR
TANK
B
(2000 GAL.)
D

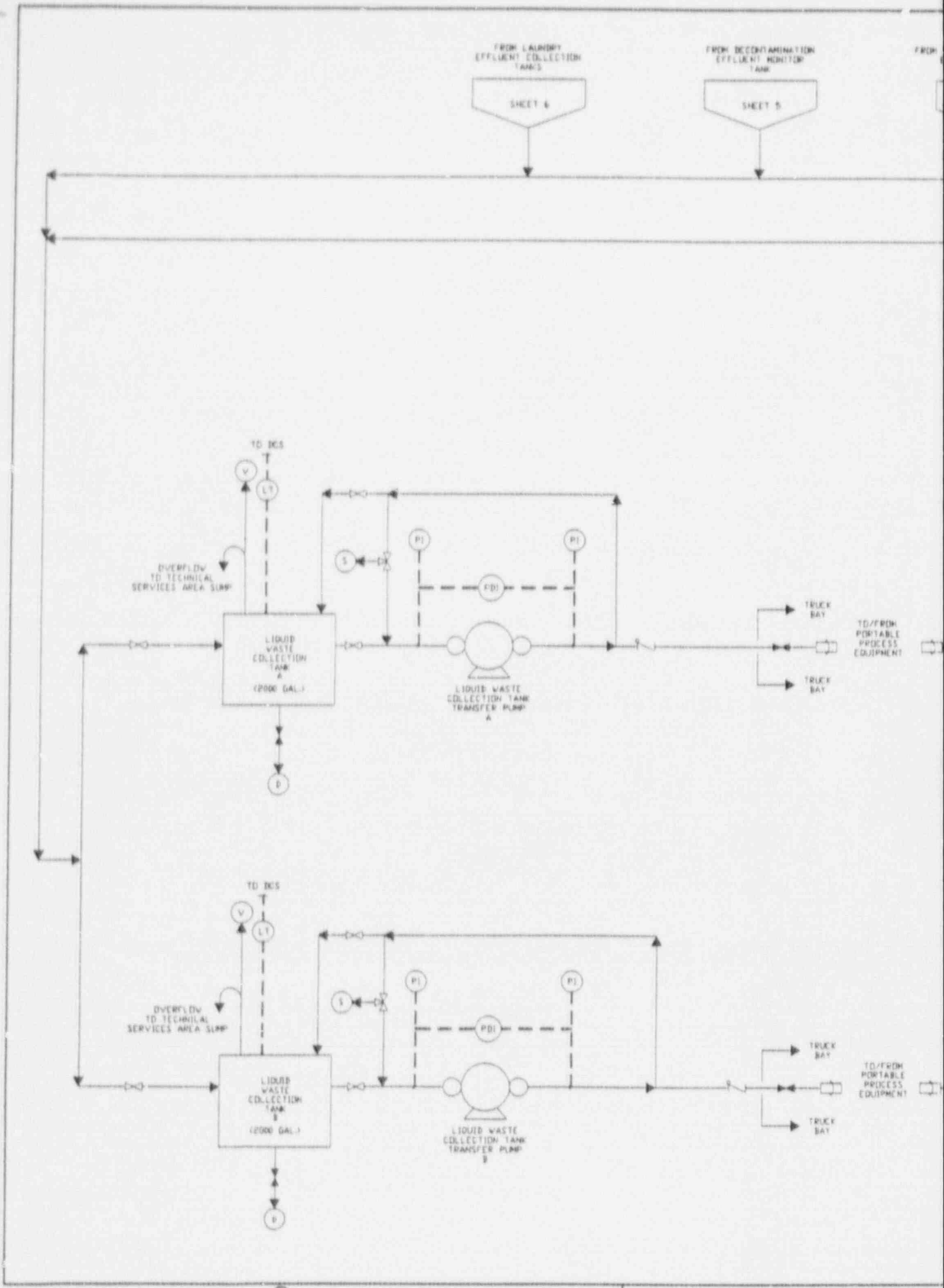


DWG. NO. 1702.06-0003 REV. 1 | SHEET 6 OF 9

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

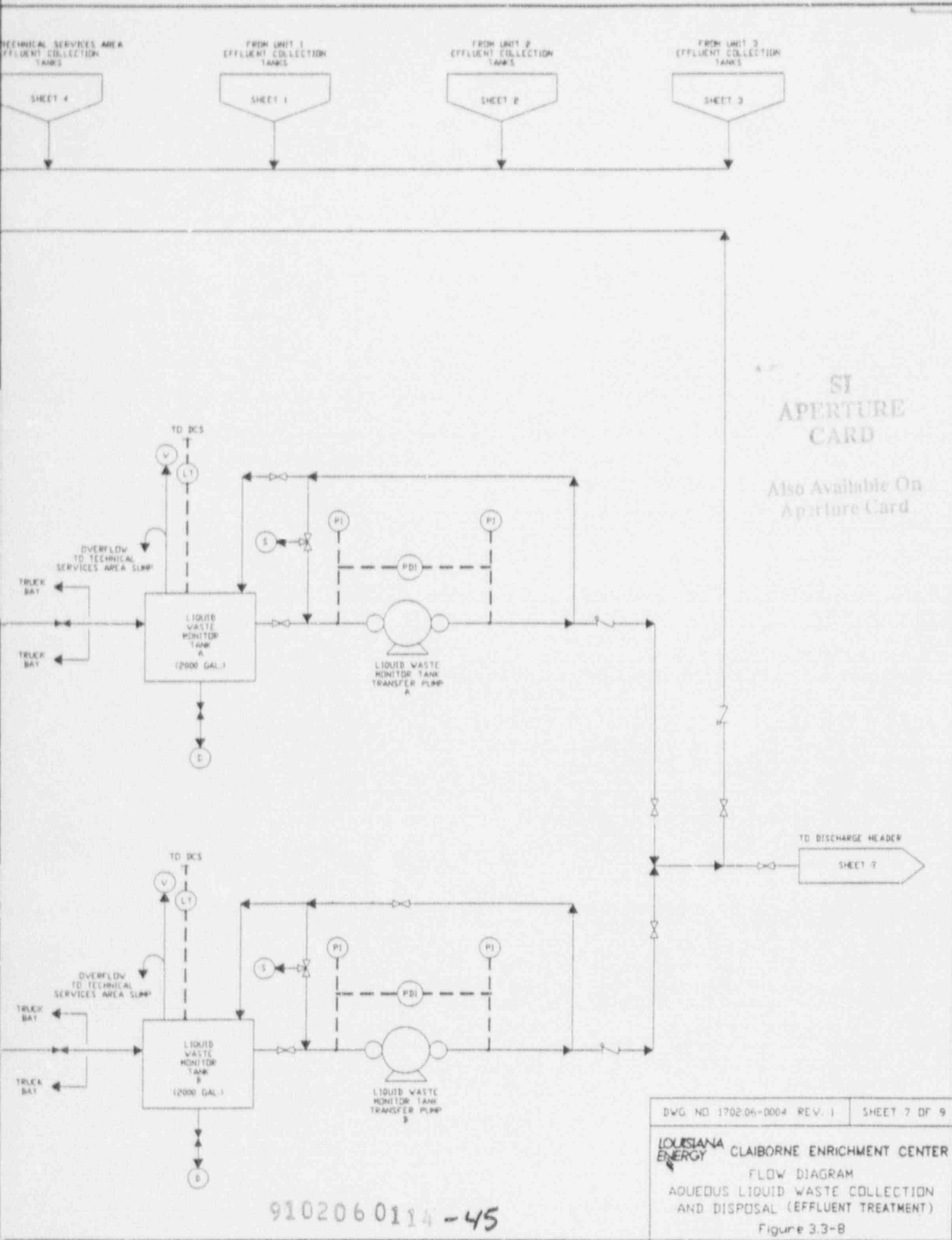
FLOW DIAGRAM
AQUEOUS LIQUID WASTE COLLECTION
AND DISPOSAL (LAUNDRY EFFLUENT)

Figure 3.3-8



FROM LAUNDRY EFFLUENT COLLECTION TANKS
SHEET 6
FROM DECONTAMINATION EFFLUENT MONITOR TANK
SHEET 5
TO DCS
V
LT
OVERFLOW TO TECHNICAL SERVICES AREA SUMP
S
PI
PDI
PI
LIQUID WASTE COLLECTION TANK A (2000 GAL.)
LIQUID WASTE COLLECTION TANK TRANSFER PUMP A
TRUCK BAY
TO/FROM PORTABLE PROCESS EQUIPMENT
TRUCK BAY
D
TO DCS
V
LT
OVERFLOW TO TECHNICAL SERVICES AREA SUMP
S
PI
PDI
PI
LIQUID WASTE COLLECTION TANK B (2000 GAL.)
LIQUID WASTE COLLECTION TANK TRANSFER PUMP B
TRUCK BAY
TO/FROM PORTABLE PROCESS EQUIPMENT
TRUCK BAY
D

3



SI APERTURE CARD

Also Available On Aperture Card

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LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

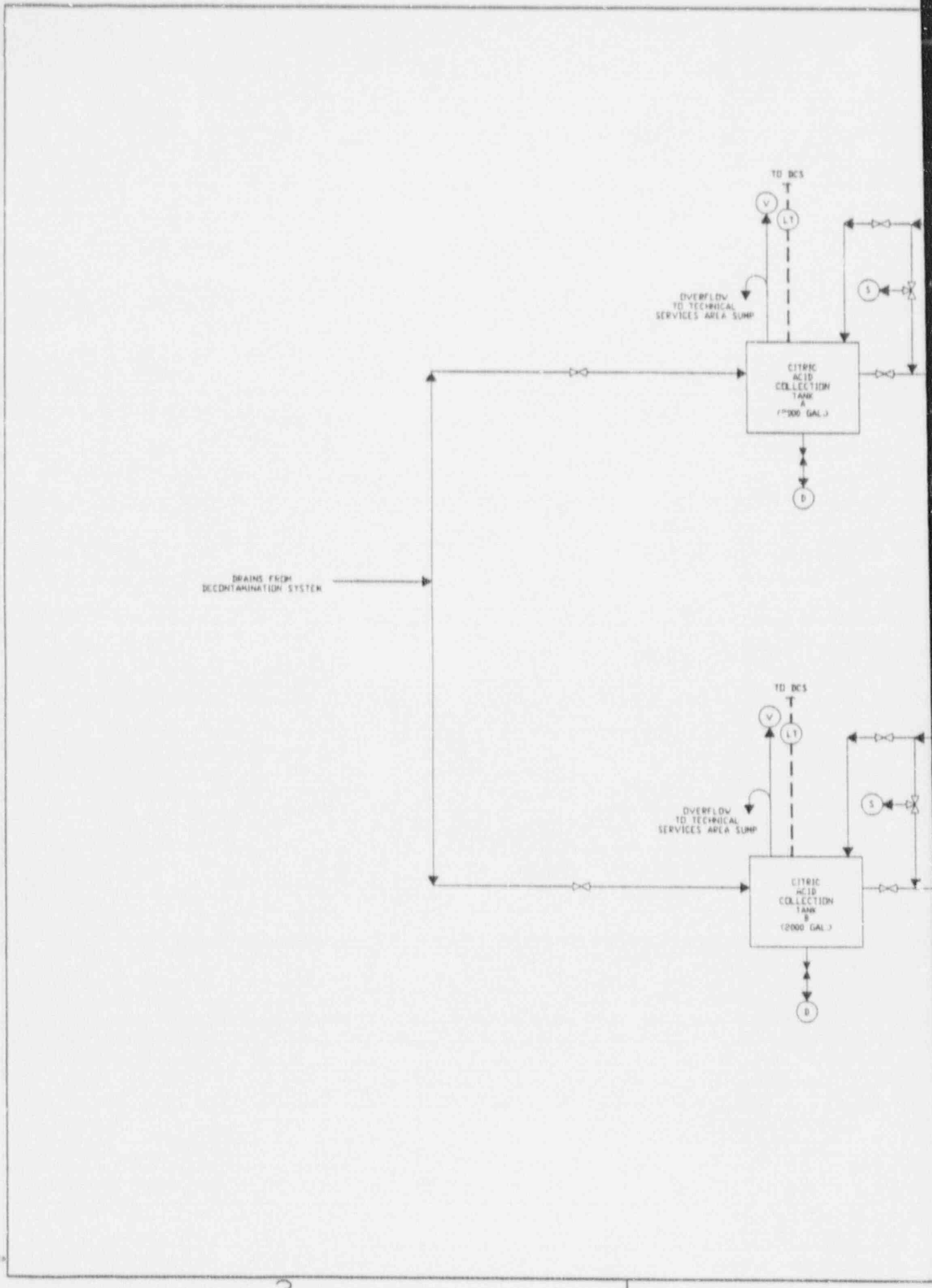
FLOW DIAGRAM
AQUEOUS LIQUID WASTE COLLECTION AND DISPOSAL (EFFLUENT TREATMENT)

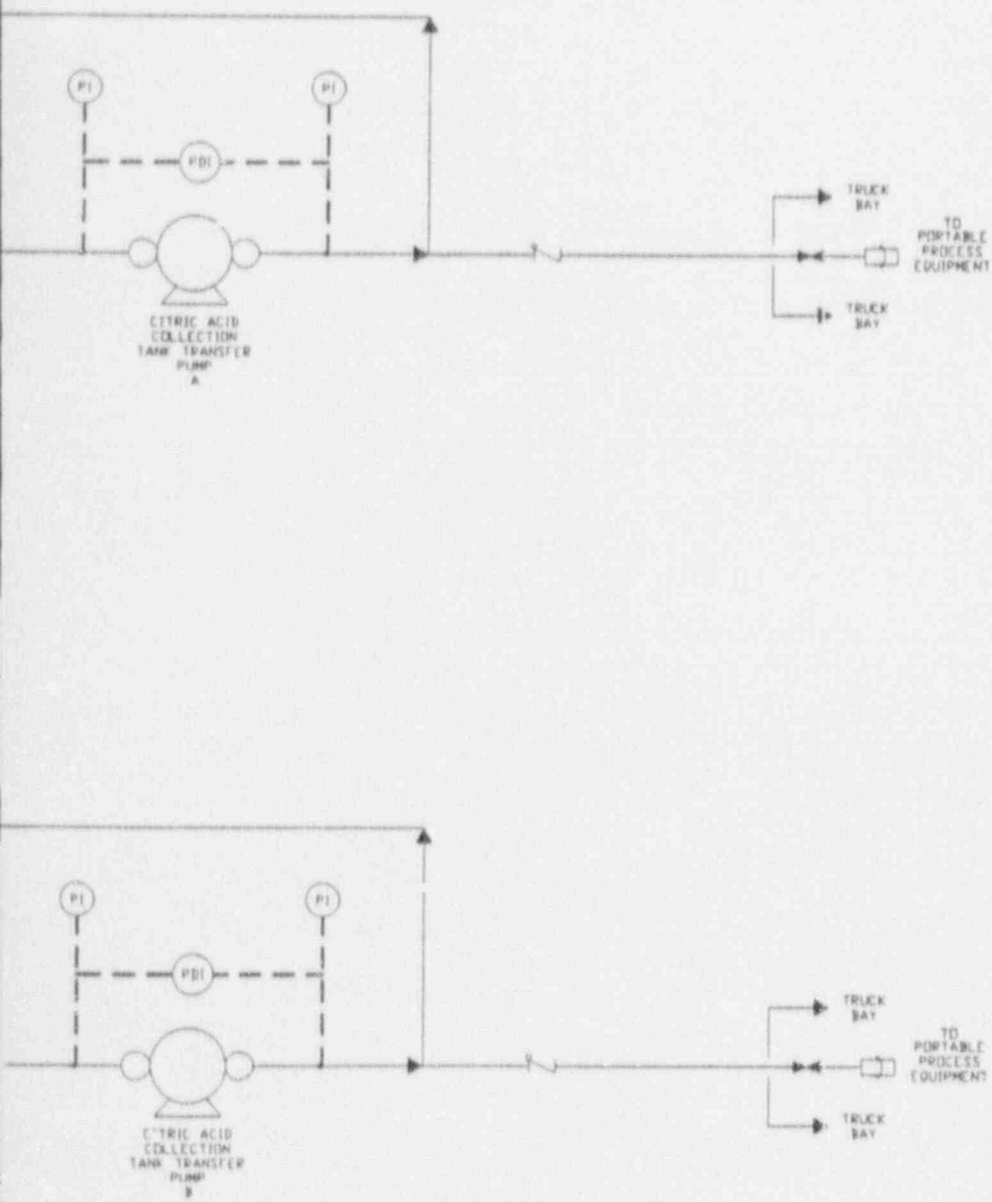
Figure 3.3-8

9102060114 -45

2 1 1

ACAD DF&6R0307


TO DCS
V
LT
OVERFLOW
TO TECHNICAL
SERVICES AREA SUMP
S
CITRIC
ACID
COLLECTION
TANK
A
(2000 GAL.)
D
DRAINS FROM
DECONTAMINATION SYSTEM
TO DCS
V
LT
OVERFLOW
TO TECHNICAL
SERVICES AREA SUMP
S
CITRIC
ACID
COLLECTION
TANK
B
(2000 GAL.)
D
3



9102060114-46

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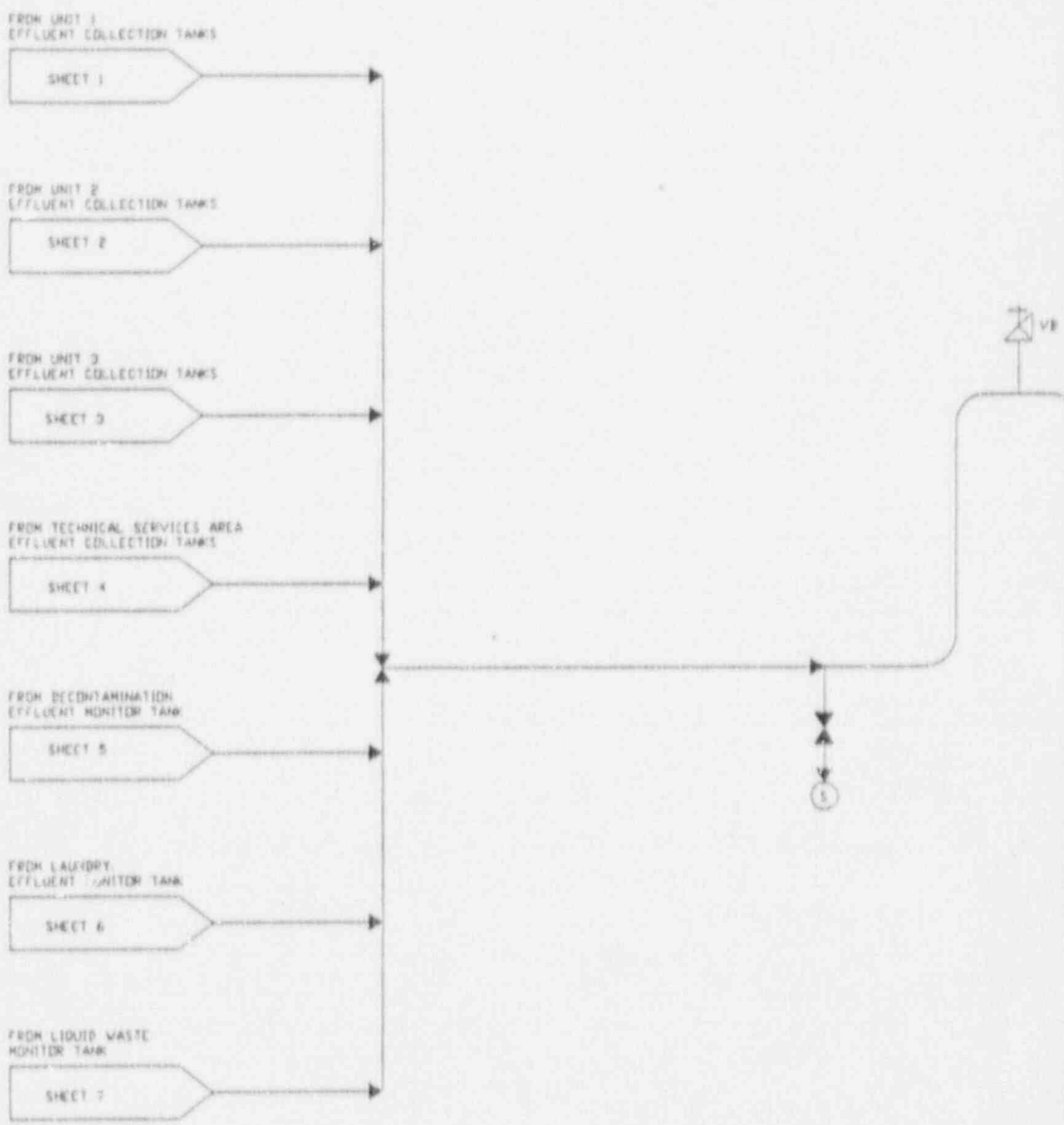
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

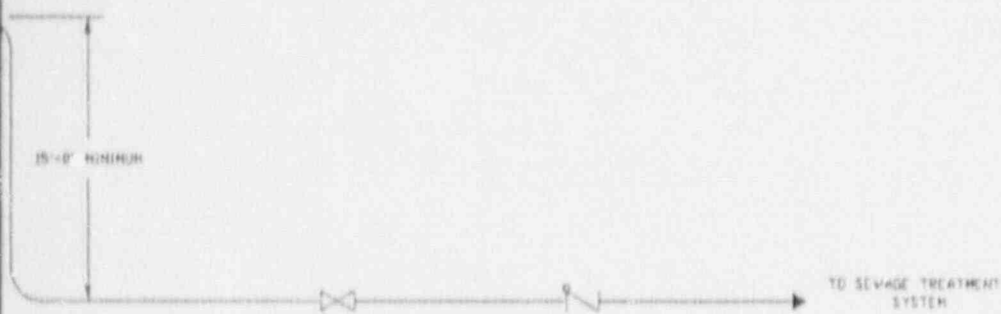
FLOW DIAGRAM

AQUEOUS LIQUID WASTE COLLECTION AND DISPOSAL (CITRIC BATH EFFLUENT)

Figure 3.3-8

2 1


FROM UNIT 1
EFFLUENT COLLECTION TANKS
SHEET 1
FROM UNIT 2
EFFLUENT COLLECTION TANKS
SHEET 2
FROM UNIT 3
EFFLUENT COLLECTION TANKS
SHEET 3
FROM TECHNICAL SERVICES AREA
EFFLUENT COLLECTION TANKS
SHEET 4
FROM DECONTAMINATION
EFFLUENT MONITOR TANK
SHEET 5
FROM LAUNDRY
SHEET 6
FROM LIQUID WASTE
MONITOR TANK
SHEET 7



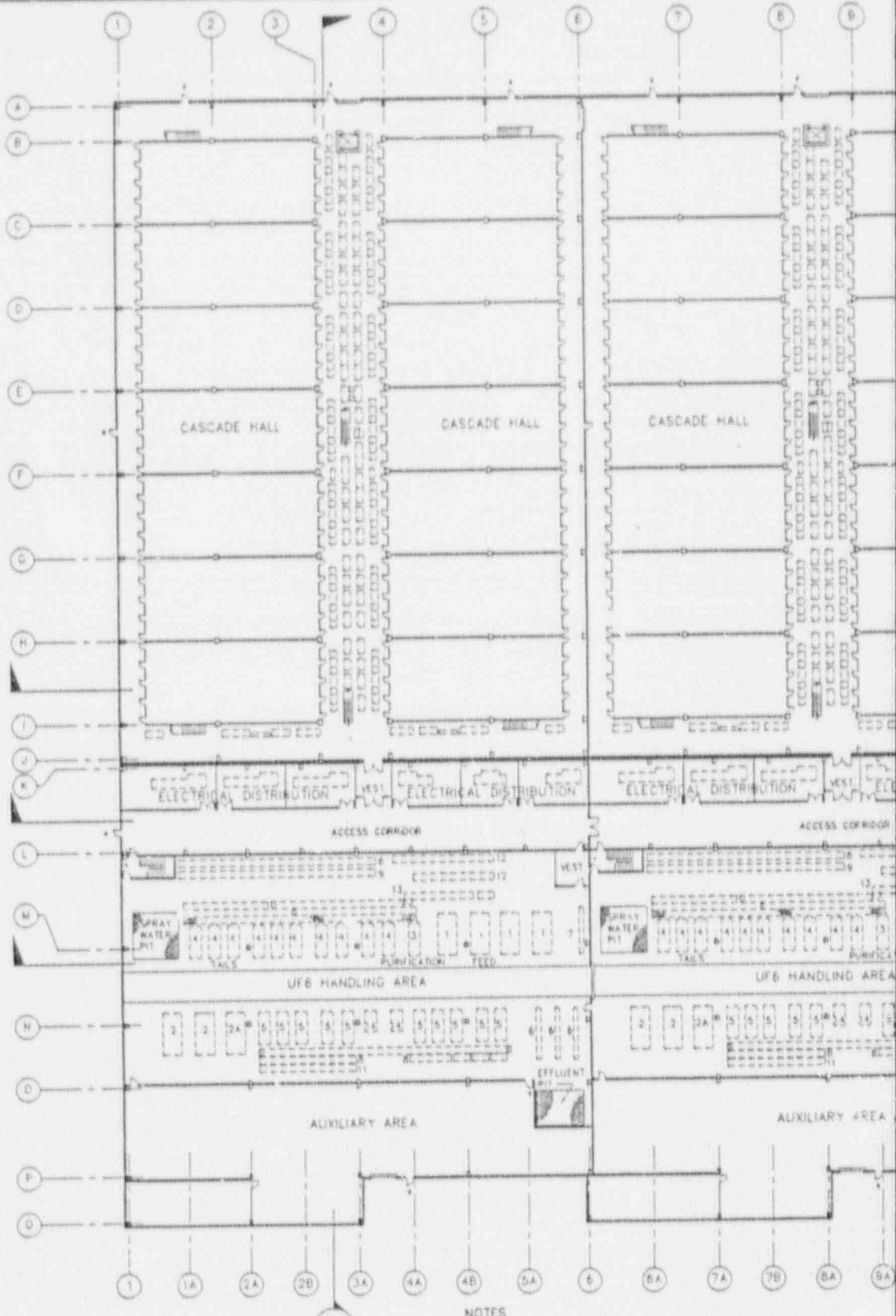
DWG. NO. 1702.06-0006 REV. 1	SHEET 9 OF 9

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

FLOW DIAGRAM
AQUEOUS LIQUID WASTE COLLECTION
AND DISPOSAL (EFFLUENT DISCHARGE)
Figure 3.3-8

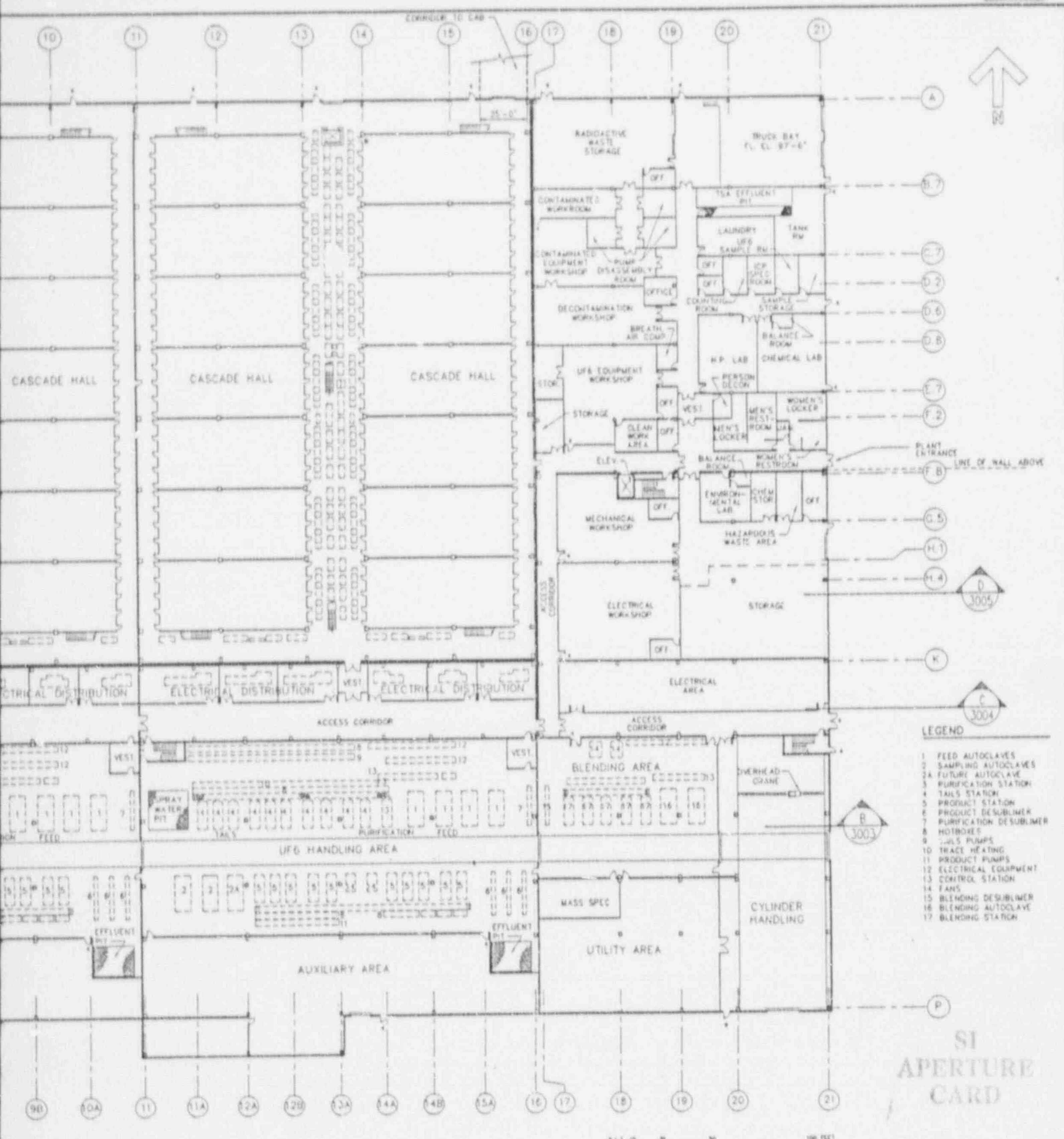
2 1

ACAD BFVER3309



NOTES

1. PORTABLE FIRE EXTINGUISHERS SHALL BE INSTALLED IN ACCORDANCE WITH N.F.P.A 10
2. * * ALARMED EMERGENCY EXIT DOOR



DWG NO. 4-30-D-3000 REV.03 | SHEET 1 OF 1

FLUOR DANIEL

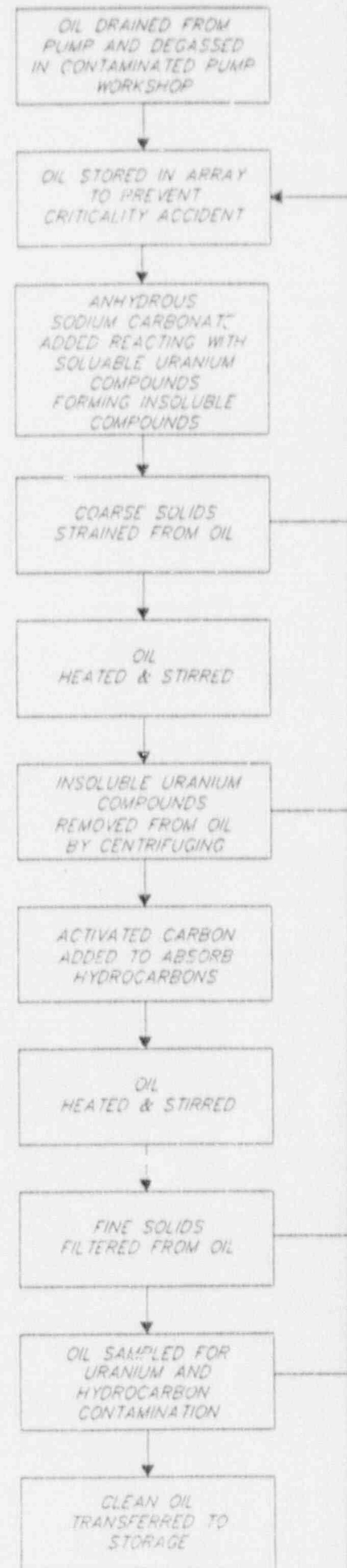
LOUISIANA ENERGY — CLAIBORNE ENRICHMENT CENTER

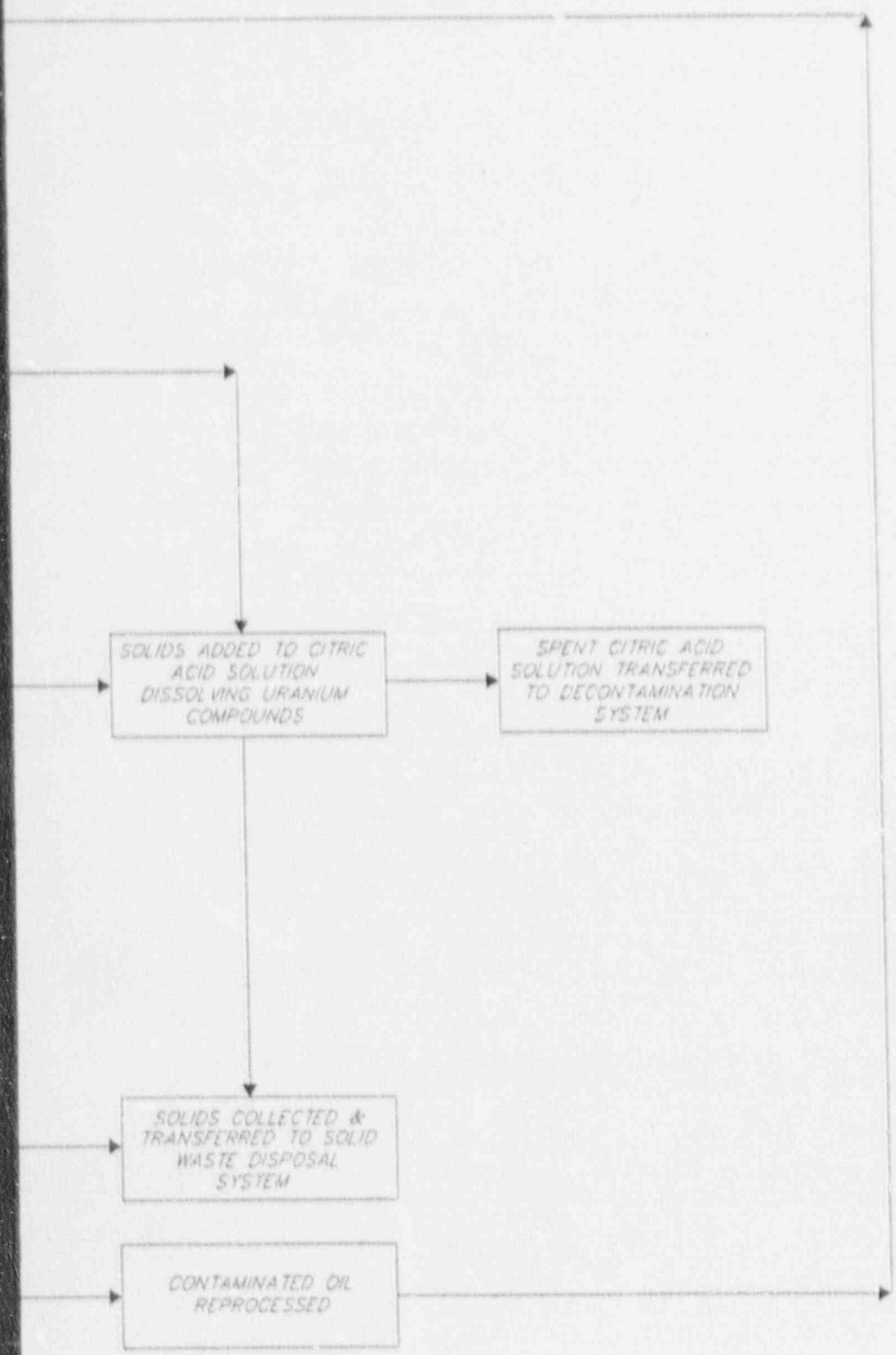
SEPARATIONS BUILDING FLOOR PLAN

Figure 3.3-9

9102060114 -48

ACAD DF=ER339


OIL DRAINED FROM PUMP AND DEGASSED IN CONTAMINATED PUMP WORKSHOP
OIL STORED IN ARRAY TO PREVENT CRITICALITY ACCIDENT
ANHYDROUS SODIUM CARBONATE ADDED REACTING WITH SOLUABLE URANIUM COMPOUNDS FORMING INSOLUBLE COMPOUNDS
COARSE SOLIDS STRAINED FROM OIL
OIL HEATED & STIRRED
INSOLUBLE URANIUM COMPOUNDS REMOVED FROM OIL BY CENTRIFUGING
ACTIVATED CARBON ADDED TO ABSORB HYDROCARBONS
OIL HEATED & STIRRED
FINE SOLIDS FILTERED FROM OIL
OIL SAMPLED FOR URANIUM AND HYDROCARBON CONTAMINATION
CLEAN OIL TRANSFERRED TO STORAGE



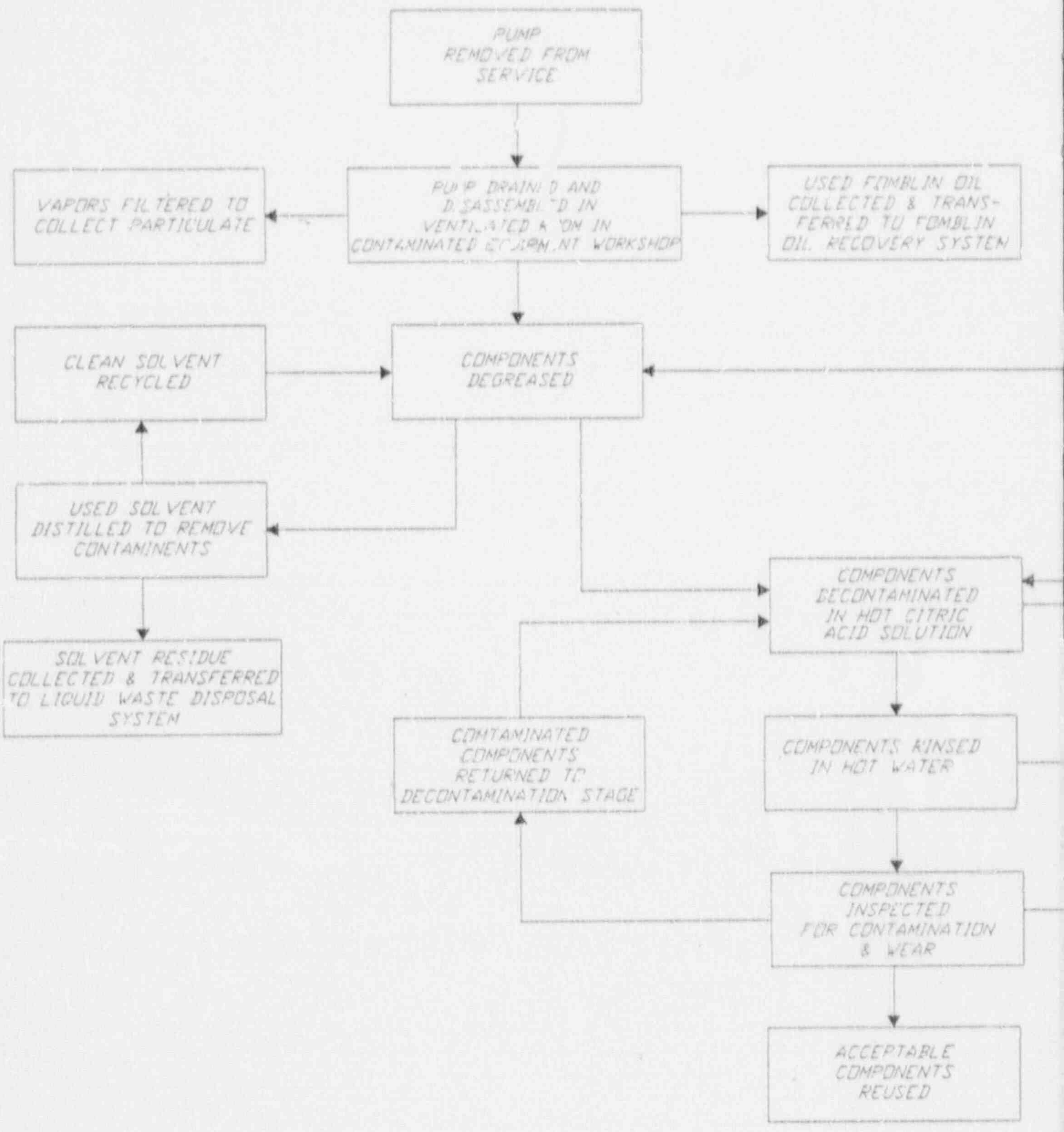
DWG. NO. 1708.13-0001 REV. 1	SHEET 1 OF 1

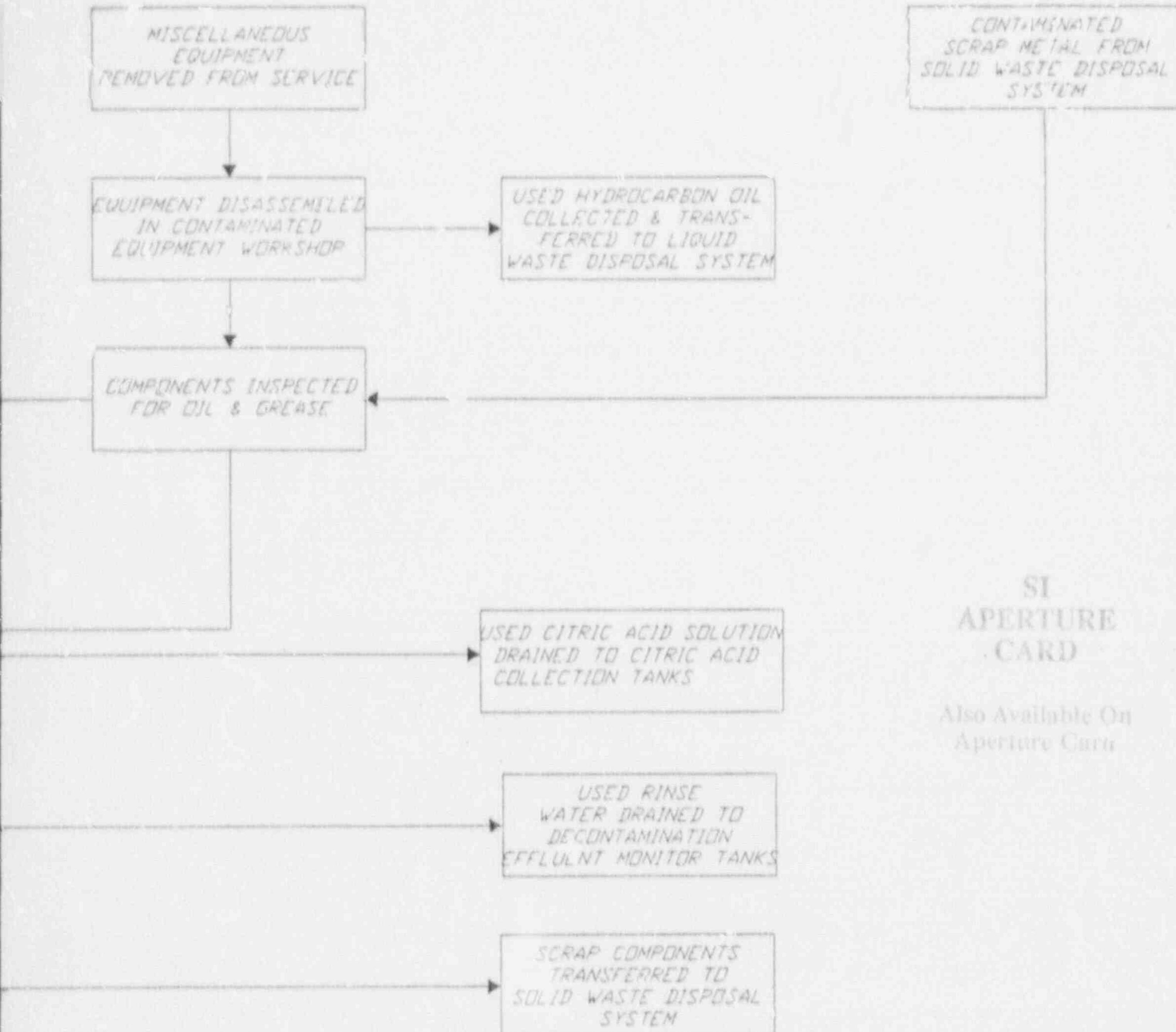
LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

LOGIC DIAGRAM

FOMBLIN OIL RECOVERY SYSTEM

Figure 3.3-10

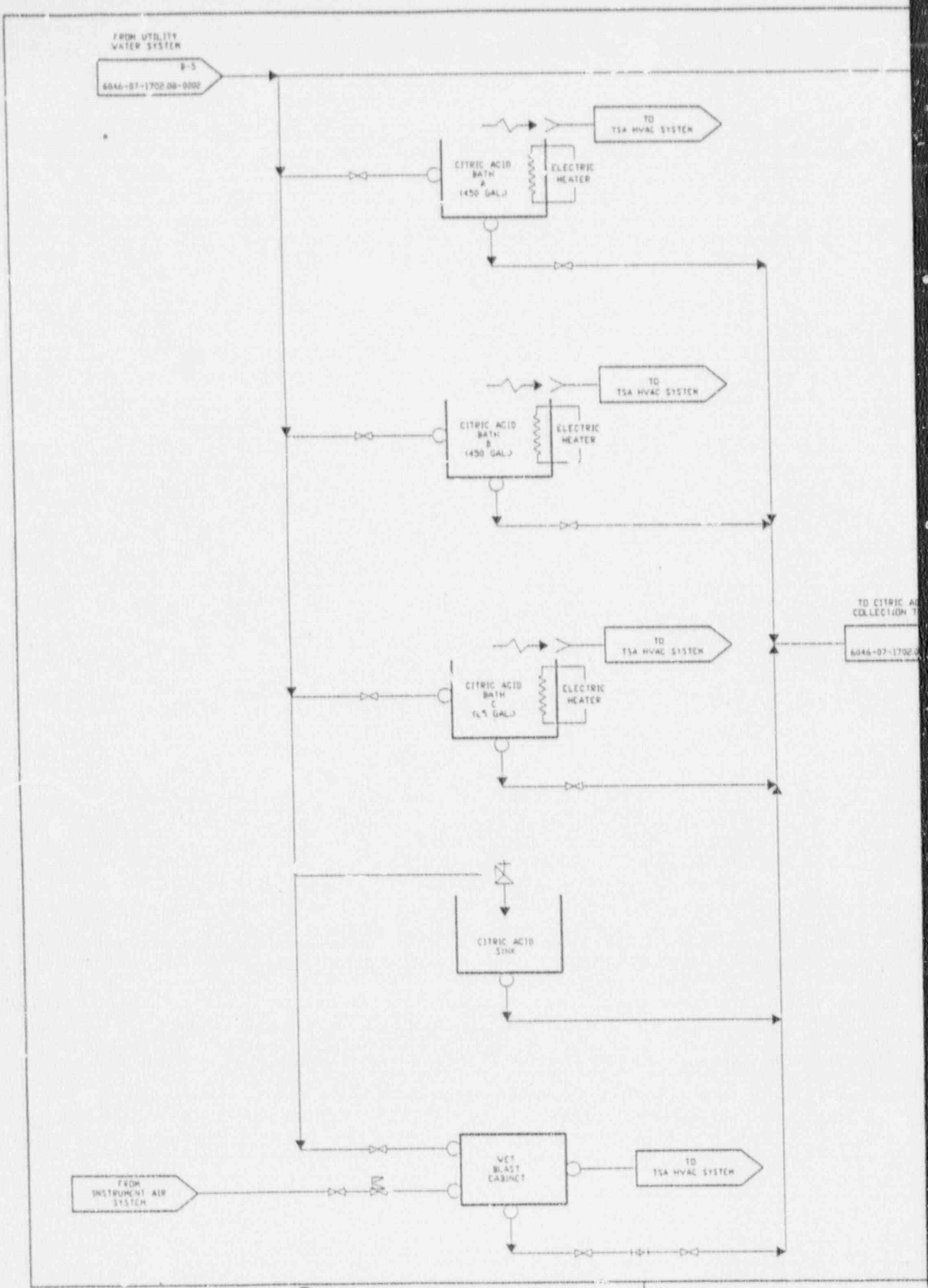

PUMP REMOVED FROM SERVICE
VAPORS FILTERED TO COLLECT PARTICULATE
PUMP DRAINED AND DISASSEMBLED IN VENTILATED ROOM IN CONTAMINATED EQUIPMENT WORKSHOP
USED FOMBLIN OIL COLLECTED & TRANSFERRED TO FOMBLIN OIL RECOVERY SYSTEM
CLEAN SOLVENT RECYCLED
COMPONENTS DEGREASED
USED SOLVENT DISTILLED TO REMOVE CONTAMINENTS
SOLVENT RESIDUE COLLECTED & TRANSFERRED TO LIQUID WASTE DISPOSAL SYSTEM
COMPONENTS DECONTAMINATED IN HOT CITRIC ACID SOLUTION
CONTAMINATED COMPONENTS RETURNED TO DECONTAMINATION STAGE
COMPONENTS RINSED IN HOT WATER
COMPONENTS INSPECTED FOR CONTAMINATION & WEAR
ACCEPTABLE COMPONENTS REUSED



LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

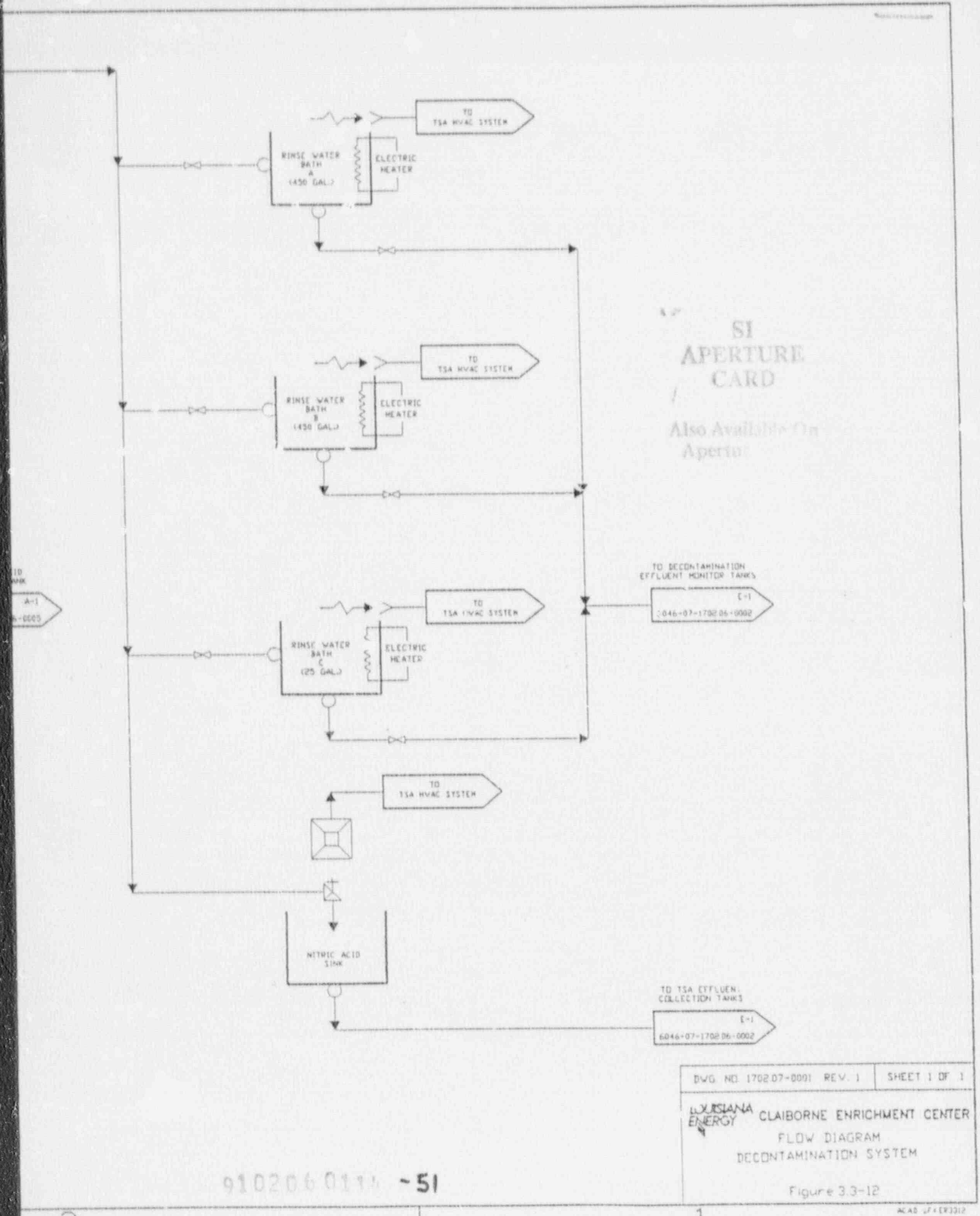
LOGIC DIAGRAM DECONTAMINATION SYSTEM

Figure 3.3-11



FROM UTILITY WATER SYSTEM
B-5
6046-07-1702.08-0002
TO TSA HVAC SYSTEM
CITRIC ACID BATH A (450 GAL)
ELECTRIC HEATER
TO TSA HVAC SYSTEM
CITRIC ACID BATH B (450 GAL)
ELECTRIC HEATER
TO CITRIC AC
COLLECTION T
6046-07-1702.0
TO TSA HVAC SYSTEM
CITRIC ACID BATH C
ELECTRIC HEATER
CITRIC ACID SINK
WET BLAST CABINET
TO TSA HVAC SYSTEM
FROM INSTRUMENT AIR SYSTEM

3



9102060114 -51

Louisiana Energy Services
Environmental Report
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4.0 ENVIRONMENTAL EFFECTS OF SITE PREPARATION, PLANT CONSTRUCTION, AND OPERATION

Environmental effects of site preparation, plant construction and plant operation, both adverse and beneficial, are discussed in this section. Measures taken to reduce any undesirable effects of the total project are described.

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List of Figures

4.1 EFFECTS OF SITE PREPARATION AND PLANT CONSTRUCTION

This section discusses the effects of site preparation and construction activities on land use and water use and the consequences to both human and wildlife populations.

4.1.1 LAND USE

The LES enrichment facility site located in Claiborne Parish, LA occupies a total area of 442 acres. Construction activities, including permanent plant facilities and temporary construction facilities, directly affect approximately 70 acres of recently clearcut mixed regrowth pine and hardwood forest land.

Aerial photographs from 1950 and 1955 (Figures 4.1-1 and 4.1-2) indicate that most of the land was pasture during this period. Later aerial photograph (Figure 4.1-3, 1978) indicates that the site is heavily wooded. Prior to LES purchase of the site property, harvesting of the timber by the previous owner was in progress and completed in July 1990 as evidenced by the aerial photographs taken in August 1990 (Figures 2.1-5 and 2.1-6).

Figure 4.1-4 indicates the pre-construction topography in the site area. The plot plan and site boundary of the permanent facilities are shown on Figure 2.1-8. Figure 4.1-5 indicates the areas to be cleared for construction activities.

4.1.1.1 Schedule and Staffing Requirements

Construction activities (site preparation) at the site are scheduled to begin in February 1993 with pouring of the first permanent concrete foundation starting in July 1993. A highlighted schedule is shown in Table 4.1-1.

The estimated yearly average number of construction employees at work on the LES enrichment facility during construction is presented in Table 4.1-2. Commercial operation of Unit 1 will begin while Units 2 and 3 are still under construction or in pre-operational testing. Therefore, there will be operations personnel on site as well as construction personnel. The estimated number of operation personnel on site is also presented in Table 4.1-2. A peak construction force of about 400 persons is anticipated during 1995 and 1996. The peak and yearly averages include all employees working at the site, including administrative, supervisory, technical, and clerical personnel. The facility will be staffed around the clock by operations personnel once commercial operation begins since the facility will operate 24 hours a day.

During early construction stages of the project, the work force is expected to consist primarily of structural crafts with a transition to predominantly mechanical and electrical crafts in the later stages. The majority of craft workers to be employed at the site are from the surrounding communities and area. LES' construction experience indicates that about 85 percent of the workforce for this project will commute from the neighboring communities; and 10 percent will move to the area from within the state with the remaining 5 percent will come from out-of-state locations (Reference 1).

4.1.1.2 Access Roads

The portion of existing Parish Road 39 that enters the site from Louisiana Route 9 on the north side will be used for truck and automobile traffic for all phases of construction and facility operation. Use of this section of Road 39 ratner than the section to the south of the site will reduce the impact of vehicular traffic to neighbors of the facility on Parish Road 39. Construction materials are to arrive at the site by truck. Traffic problems are to be reduced by providing parking and unloading points for commercial carriers off the public roads and access roads. Onsite parking is provided for construction workers and visitors. Station construction is expected to cause some increase in traffic on local roads. The 1988 and 1989 traffic count figures for Louisiana Route 9 between Homer and Summerfield are 1660 and 1809 vehicles per day, respectively (Reference 2). It is anticipated there will be 200-300 private vehicles accessing the site daily during the period of peak construction activities. This increase in traffic for short periods each day should not cause major delays to local traffic (Reference 1). The Louisiana Department of Transportation will be consulted before the start of construction concerning the effects of construction traffic on the local roads.

4.1.1.3 Facility Construction

Facility construction is scheduled to commence with site preparation in February 1993. Construction methods and procedures are aimed at minimizing the impact on the area environment.

When the site area is prepared for construction, only the minimum amount of additional necessary clearing is done.

Those areas in the site vicinity that may be cleared of all vegetation are shown on Figure 4.1-5. Excavation, filling, and spoiling are done only within the cleared areas. Areas not needed for the permanent plant facilities are restored by suitable landscaping to blend with the natural terrain. Seeding and restoration planting are done as soon after construction as possible.

During construction, efforts are made to minimize the environmental impact. Erosion, sedimentation, dust, smoke, noise, unsightly landscape, and waste disposal are controlled to practical levels and permissible limits, where such limits are specified by regulatory authorities. In the absence of such regulations, LES abides by dictates of good citizenship.

The term "Dictates of good citizenship" is simply a common sense term that means those policies and procedures that society abides by in everyday living. They are not laws LES is required to abide by, instead, they are everyday actions that any good citizen and neighbor would practice to keep his or her home or business clean and neat as conditions will allow while not being a nuisance to themselves or neighbors.

Good drainage, dry weather wetting, and the paving of the most heavily traveled roads reduces the dust generated by vehicular traffic. Bare areas are provided with a ground cover wherever and whenever practicable.

Erosion in the construction area and the resulting sedimentation is controlled by providing piped drainage systems, intercept and berm ditches, and ground covers where necessary to control the flow of surface water. Spoiled materials are deposited in a controlled manner such that high water or surface runoff do not transport materials to adjacent water ways.

Excessive and objectionable construction noises are reduced to acceptable levels. Contractor's and Company's motor powered equipment are equipped with noise reducing equipment and are maintained in good order. Tree lined fringes, left around most of the construction area for visual pollution abatement, contribute to noise reduction.

Care is taken to control smoke and other undesirable emissions to the atmosphere during construction. Combustible debris generated by station construction will be burned under provisions of permits issued by state and local authorities. If permits are not made available, materials will be buried in a spoiled fill area. LES adheres to air pollution control regulations applicable to Claiborne Parish and the State of Louisiana, as they relate to open burning and the operation of certain fuel-burning equipment. Permits and operating certificates are applied for as required. All reasonable precautions are taken to prevent accidental fires on the construction site and brush or forest fires on adjacent lands.

Wastes, such as chemicals, fuels, lubricants, bitumens, and raw sewage, are not deposited onto the natural watershed where surface runoff can transport these materials off site. Waste products will be handled in accordance with state and local laws. A sewage treatment facility, which will meet the standards required by these laws, will be on site. Bitumens, such as asphalt waste, are the responsibilities of the supplier and are not disposed of on the construction site. A spill control program in case fuels are inadvertently spilled will be implemented. Solid construction waste, such as foliage, packing materials, rags, scrap iron, etc., is either buried or transported off site to an approved landfill.

Construction buildings, storage and maintenance areas, and parking areas are maintained in a neat manner to improve the construction plant appearance. Construction yards, construction substations, employee and office parking areas, and construction office are temporary and are suitably landscaped to blend with the natural and developed landscape.

The permanent fire protection system is installed as soon as excavation and backfill operations permit and is maintained during the remainder of the construction program.

The final construction activities scheduled at the LES Site are to be the removal of construction facilities and the final grading and landscaping of the station site.

4.1.1.4 Effects on Terrain

Construction activities are not expected to have any adverse effects on the terrain outside the construction area. Effects on the terrain are to be confined to the project area where construction activities are to include: clearing, grubbing, excavation, filling, grading, stock-piling, and building. These alterations are not expected to cause any permanent adverse effects.

The anticipated effect of clearing operations on the terrain is the short term increase in potential soil erosion, which will be mitigated by proper construction techniques. Erosion control measures will be implemented as necessary.

Berms and dikes are constructed as necessary. Interceptor ditches are built to protect side hill cuts. Cleared areas, cuts, and fills are seeded as soon as possible. Sheet piling and bagging are used to control erosion as needed. Fugitive dust is controlled by use of watering and natural windbreaks. All drainage from the construction area will be into the Hold-up Basin (See Figure 3.1-2) which will reduce sediment transport off site.

A secondary effect of the clearing operations on the terrain is a reduction in natural aesthetic quality. However, as much of the site as practicable is to be cleaned up and landscaped with appropriate grasses, shrubs, and trees after construction.

The earthwork volumes to be moved (cut and fill), shown in Table 4.1-3, are the best available estimates at the time of application. Due to plant facility layout changes, further refinement will optimize necessary earthwork to minimize spoil materials.

4.1.1.5 Effects on Vegetation and Wildlife

As part of the construction of the LES facility, vegetation in the immediate facility area is to be completely cleared. This will result in the loss of the use of approximately 70 acres of the 442 acre site for the lifetime of the plant. Of these 70 acres, approximately 50 acres are recently (within the last year) harvested upland mixed pine/hardwood forest, 14 acres are upland pine forest, and 6 acres are upland mixed pine/hardwood forest harvested 5 to 10 years ago (see Section 2.7.1 and Figure 2.7-1). Construction of the Hold-Up Basin will result in the loss of use of approximately 3 additional acres of recently harvested upland mixed pine/hardwood forest. Commercially important timber species that will be lost from these habitats as a result of plant and Hold-Up Basin construction include loblolly pine, southern red oak, red maple, and sweetgum.

Impacts on the plant community are expected to be limited to the loss of vegetation in the immediate construction area. Dust generation during clearing and construction will be controlled and, therefore, is not likely to interfere (by covering leaf surfaces) significantly with photosynthesis in adjacent vegetation. No herbicides, growth retardants, or sprays are to be used in clearing operations. No threatened or endangered plants are known to occur in the general vicinity of the proposed facility.

Clearing and construction will result in the displacement of terrestrial wildlife species inhabiting the 70 acres of upland forest habitats on which the facility and Hold-Up Basin will be constructed. The number of individuals from any given species that is displaced as a result of construction will vary along with species-specific habitat requirements and population densities (see Section 2.7.2 for this information).

For example, eastern cottontail, which are likely to inhabit the 51 acres of recently harvested upland mixed pine/hardwood forest to be completely cleared during plant and Hold-Up Basin construction, can reach densities of between 1 and 8 animals/acre. Therefore, between 51 and 408 cottontail could be displaced as a result of facility construction. The actual number of cottontails that could be displaced is most likely toward the lower end of this range given that favorable cottontail habitat was only recently created in the proposed construction area as a result of timbering in 1990; therefore, high population densities are not yet likely. Striped skunk, which could inhabit the entire 70-acre area to be cleared, can reach densities of 1 skunk/10 acres. Therefore, 7 skunk could be displaced as a result of facility construction. Similarly, assuming a carrying capacity of 1 whitetail deer per 50 acres for northwest Louisiana forests (Reference 3), approximately 1 deer could be displaced as a result of facility and Hold-Up Basin construction. (Cottontail and deer were selected as important wildlife species for the proposed site. See Section 2.7.2)

A variety of edge and scrub-shrub associated bird species, such as rufous-sided towhee, song sparrow, and American goldfinch also will be displaced. Other species which are distributed in more mature forest stands (e.g., gray squirrels), in forest interiors (e.g., hairy woodpecker, yellow-billed cuckoo, and red-eyed vireo), in bottomlands and along drainage ways (e.g., raccoon, cotton mouse, upland chorus frog), or in ponds and lakes (e.g., beaver, wood duck, bullfrog) will not be impacted directly by the loss of 70 acres of upland forest habitat. No threatened or endangered wildlife species are known or expected to use the site.

The displacement of wildlife species from the 70 acre facility and Hold-Up Basin is not likely to impact the wildlife community of the proposed site as a whole or that of the surrounding area. The forest habitats displaced as a result of clearing and construction are prevalent in other portions of the site as well as in the surrounding areas, and therefore, wildlife that have been displaced from the facility area can disperse to suitable habitats on the CEC property or in the surrounding area. This could result in slight increases in wildlife population densities or wildlife dispersion in areas immediately adjacent to the facility site, but such increases are unlikely to be significant or long-term given the size of the lost habitat relative to that of the available habitat in the surrounding area.

The construction of the facility also could result in the destruction of individuals of smaller wildlife species, such as five-lined skink, ground skink, six-lined racerunner, and least shrew, which are less visible and which could be caught under operating machinery or under excavated or graded material. Additionally, increased traffic on Parish Road 39 during construction could result in an increased loss of wildlife, particularly of smaller species. For example, Nicholoson (Reference 4) found that vehicular traffic had a detrimental effect on tortoise populations near roads, presumably due in part to increased traffic deaths. Similarly, wildlife populations near Parish Road 39 could be negatively impacted as a result of increased vehicle traffic. However, construction or traffic-related losses are unlikely to significantly impact the wildlife populations of the entire site or the surrounding area given that the size of the populations in these other areas is likely to be large relative to the number of individuals lost as a direct result of construction or increased traffic.

Increased traffic and human activity during construction also could disrupt the movements of some wildlife species in the area. Further, increased noise could affect intra- and inter-species interactions by masking vocalizations necessary for rearing of young or for predator detection or defense. Although it is possible that some species could suffer long-term impacts from these types of disturbances, most are likely to be affected only temporarily during the three-year construction period.

4.1.1.6 Effects on Human Activities

The major impact of facility construction on human activities is expected to be a result of the influx of labor into the area on a daily or semi-permanent basis.

The bulk of the labor force is expected to come from Claiborne Parish and the surrounding parishes. An increase in vehicular traffic is expected. There is expected to be an expansion of small business in the area.

The expected benefits derived by the local populace from construction of the station outweigh the usual minor inconveniences associated with that construction, or construction of any large industry.

Temporary external costs of building the facility are as follows:

4.1.1.6.1 Noises

Environmental effects of excessive noise levels include induced hearing loss and annoyance to inhabitants of the area. It is highly unlikely that either of these will occur during construction of the CEC. The reasons for this are as follows:

a. Based on measurements at other construction sites, it is expected that the overall noise levels during construction at the LES property boundary will be in the 45-73 db(A) range. This will occur during the period of site excavation when large earth moving equipment is in operation.

Transmission of noise is affected by wind direction and velocity, topography, building and natural screening such as trees. While no absolute value can be predicted for each location and physical and meteorological conditions, about 63 db(A) could be expected at a point on a clear line of sight at a distance of 2500 feet from the source of the noise. This value would be reduced if a clear line of sight did not exist.

An observer in the site vicinity would probably detect total levels of 45 to 73 db(A), but these noise levels will not cause physical damage.

b. The annoyance factor varies widely with individuals and the degree of acceptability by inhabitants near the boundary is quite difficult to establish.

Criteria that consider average public reaction to varying noise levels have been developed. When used as a basis for determining the reaction to anticipated levels, these criteria indicate no widespread complaints at daytime levels during the construction period. Noise levels during operation are expected to be much lower at the LES property boundary. When subjected to the same criteria, no adverse public reaction would be anticipated.

4.1.1.6.2 Community Services and Facilities

Based on experience, only about 15 percent of the construction work force (60 people) are expected to move into the vicinity as new residents. This increase due to construction activities will be temporary and is not expected to affect the normal year to year attendance variations in the local schools.

The housing market in Claiborne Parish is in a depressed state with many properties for sale. The relatively small influx caused by the CEC is not anticipated to burden or cause inflation to the real estate market.

The hospital closest to the site, located in Homer, Louisiana, will be affected slightly. This hospital will be used for obtaining emergency medical treatment for the construction workers when necessary. The building of additional hospitals in the vicinity will not be necessary. Minor illnesses or accidents will be treated at the onsite First Aid Station.

The development of new fire departments or police departments will not be needed, since LES will be equipped with its own Fire Protection System and Security Force.

4.1.1.6.3 Traffic

The construction of the facility will cause some increase in vehicular traffic on the local roads. LES plans to discuss the effects of the increase in traffic on existing local roads with the Louisiana Department of Transportation to determine if any modifications are necessary. Suitable access roads will be built in the construction area to accommodate construction traffic. Onsite parking will be provided for the construction force.

4.1.2 WATER USE

Site preparation and plant construction may potentially effect both surface water and shallow groundwater near the facility. The potential effects on surface water and groundwater are addressed separately in this section.

4.1.2.1 <u>Effects on Surface Water</u>

The two primary effects of site preparation and plant construction are siltation of surface water bodies and volume changes associated with altering the drainage areas.

4.1.2.1.1 Siltation

The impact of siltation on existing water bodies will be minimal due to the implementation of an erosion control plan. The erosion control plan includes the construction of a Hold-up Basin southwest of the facility, just upstream from Bluegill Pond. During the facility construction period, all yard drainage will be routed to the Basin. The Hold-up Basin will be constructed having an initial capacity of approximately 38 acre-ft. During the construction period, approximately 11 acre-feet of sediment is expected to be captured in the Hold-up Basin. The outlet works for the Hold-up Basin is designed to limit the discharge velocity in order to achieve acceptable settling efficiency.

In addition to the Hold-up Basin, soil erosion and transport is expected to be controlled and minimized during construction by such measures as: incremental clearing, external and internal water diversions, water breaks to divert runoff to stabilized areas, temporary grassing and permanent grassing. Mobilized sediment will be contained by silt fences and sediment traps.

4.1.2.1.2 Potential Effect on Lake Avalyn

Construction of the CEC facility may potentially impact Lake Avalyn since a portion of the drainage basin area will be altered by the facility. An analysis was performed to investigate the impact of altering the drainage basin. The analysis assumes that the altered area (approximately 37 acres) will not facilitate groundwater recharge and that all runoff from this area will be collected and discharged into the Hold-up Basin. The simplified analysis conducted used data from Geraghty et al. (Reference 7). Plate 21 in Geraghty et al. (Reference 7), shows that the average annual surface-water runoff for northern Louisiana is between 15 and 20 inches (the analysis assumes the runoff is 17 inches (1.4 ft)). Average annual surface water runoff is representative of stream flow at the outlet of the drainage basin. This runoff value includes outflow of groundwater as well as surface water runoff. The surface water flow would be representative of flow at an outlet of a drainage basin as it is unaffected by artificial storage conditions such as the lake. Therefore, this analysis initially assumes that the lake itself is not present. Annual surface water runoff is presented below for both the current drainage basin of Lake Avalyn and for the modified drainage basin area (current area minus the portion of the drainage basin to be covered by the facility) based on current construction plans. The annual runoff is determined by multiplying the drainage basin areas by the average annual surface water runoff (1.4 ft).

Annual Runoff - Current Drainage Basin Area

$$7.3 \times 10^6 \text{ ft}^2 \times 1.4 \text{ ft} = 1.0 \times 10^7 \text{ ft}^3$$

Annual Runoff - Modified Drainage Basin Area

$$5.8 \times 10^6 \text{ ft}^2 \times 1.4 \text{ ft} = 8.2 \times 10^6 \text{ ft}^3$$

The decrease in the amount of annual surface water runoff from the Lake Avalyn drainage basin is 1.8×10^6 ft^3, or nearly 20% of the surface water runoff under baseline conditions. A bathymetric survey of Lake Avalyn, conducted during the baseline site investigation, estimated the total volume of Lake Avalyn to be approximately 4.0×10^6 ft^3. Therefore it is estimated that, on an annual average basis, a volume of water equal to approximately one-half of the total lake volume will not be available for recharge to the lake.

Under baseline conditions, this analysis indicates that the average annual surface water discharge is 1×10^7 ft^3, or 0.32 ft^3/sec. Because during two of the site visits this discharge was exceeded, it is likely that during some periods of the year there is an excess of water discharging through the Lake Avalyn drainage basin. However, during the summer there may be a deficit of water and the shoreline may recede, although the extremes in seasonal variation in the water level of Lake Avalyn have not been defined due to the short period of observation. Results of the bathymetric survey indicate that the lake bottom is sloped most gradually at the southernmost tip as well as along the central location of the lake. Therefore, it is likely that any drop in the water level of the lake would be observed in these areas first.

The chemistry of the lake may be affected following plant construction because less water will be available for flushing. Therefore some areas of the lake may become less well-mixed, potentially affecting the stratification or trophic state of the lake.

An assumption in the above analysis is that the entire area evaluated has similar characteristics such as soil type and vegetation. However, a review of the Soil Conservation Survey for the CEC site indicates that the site is underlain by different soil types which exhibit different soil properties. This adds some uncertainty to the above evaluation. Most of the area where the facility is to be constructed is underlain by Wolfpen loamy sand (Reference

8). This soil type is reported to have a high infiltration rate (low runoff potential) and a permeability of 6 to 20 in/hr in the upper 26 inches of the soil, decreasing to 0.6 to 2 in/hr in the deeper 26 to 78 inches of the soil profile. In contrast, the soil closer to the shoreline of Lake Avalyn is Sacul very fine sandy loam. This soil has a slow infiltration rate and permeabilities ranging from 0.06 to 2 in/hr over 65-inch depth (Reference 8). Construction of the facility will result in grading much of this area and will disturb the more permeable soils on the site, where groundwater recharge is most likely greatest. Therefore the construction will have a greater effect on decreasing the groundwater contribution to Lake Avalyn. The analysis described in this section may be an underestimation of the decrease of water available to Lake Avalyn.

As will be shown in Section 4.1.2.2, a potential effect of facility construction on the shallow groundwater may be a shift in the current drainage divide to the east (into the Lake Avalyn drainage basin). This shift will serve to further reduce the groundwater baseflow contribution to Lake Avalyn.

The degree of the effect of the decrease in the area of the drainage basin of Lake Avalyn due to construction of the CEC facility cannot be quantified at this time. However, it is anticipated that the effects will be negligible when compared to the overall seasonal variation in water level and water chemistry under natural conditions. Pre-operational monitoring will include quarterly measurements on the water level and water chemistry of Lake Avalyn to establish a data base by which to compare similar measurements once facility construction begins.

4.1.2.1.3 Potential Effect on Bluegill Pond

Construction of the CEC facility will impact Bluegill Pond in several ways. As with the potential impact on Lake Avalyn, the drainage basin area for Bluegill Pond will be decreased because a portion of the drainage basin area will be covered by the facility. Additionally, treated effluent will be discharged into Bluegill Pond, and overflow from the Hold-up Basin will also flow into Bluegill Pond.

An analysis similar to the one discussed in Section 4.1.2.1.2 was conducted to estimate the decrease in the amount of annual surface water runoff to Bluegill Pond. Given a natural drainage basin area of 2.8×10^6 ft^3 and a modified drainage basin area following construction of 2.0×10^6 ft^3, the decrease in the average annual surface water runoff is nearly 1.2×10^6 ft^3 or nearly 30% of the surface water runoff under baseline conditions. The estimated volume of Bluegill Pond is 7.4×10^5 ft^3; thus on an annual basis, water equal to approximately 1.5 times the volume of the lake will not be available for natural recharge to the lake due to the presence of the facility.

However, the construction of the facility will create additional sources of water for Bluegill Pond. It has been reported that 3 million gallons (4×10^5 ft^3) of treated effluent will be discharged into the pond each year. An additional source of water to Bluegill Pond will be created by the Hold-up Basin that is used for sediment control and collection of rainwater runoff. Overflow from the Hold-up Basin will discharge into Bluegill Pond and as discussed in Section 4.1.2.2, mounding of the shallow water table will occur beneath and in the vicinity of Bluegill Pond, most likely causing additional groundwater to supply baseflow to Bluegill Pond. Therefore, although the natural drainage basin area to Bluegill Pond will be decreased due to the presence of the facility, the storm water from the site area will ultimately be discharged into Bluegill Pond. Based on the above discussion, Bluegill Pond should not experience a noticeable change in water volume other than volume change associated with seasonal variations.

4.1.2.2 Effects of Site Preparation and Plant Construction on Groundwater

The facility will cover approximately 70 acres and is centrally located on the site. The developed portion of the property is the topographic high of the three onsite drainage basins and the groundwater divide on the property runs beneath this area. Much of this area consists of Wolfpen loamy sand which was described by Kilpatrick and Henry (Reference 8) as having a high infiltration rate (i.e., low runoff potential). In contrast, soils covering most of the remainder of the property are classified as having slow infiltration rates which would result in more runoff and less recharge to the groundwater. Additionally, because this area has relatively little topographic relief, infiltration of storm water in this area is further enhanced. Due to these factors, it is expected that this area currently contributes a majority of the recharge to groundwater in all three of the onsite drainage basins.

While some large portions of the 70 acre facility will be permeable to infiltrating storm water, most of these areas will be constructed with catchment systems designed to capture this water and hence reduce groundwater recharge. This water will be routed to the Hold-Up Basin along with captured water from impermeable areas. The Hold-Up Basin will be located upstream from Bluegill Pond in the southwest drainage basin of the property.

Under these conditions of reduced groundwater recharge in the area to be occupied by the CEC, it is likely that the shallow groundwater flow regime beneath the property will be altered. Due to the significant reduction in recharge, it is hypothesized that shallow onsite groundwater levels beneath the facility will decline and the groundwater divide will shift in the direction of lowest gradient (i.e., to the east and southeast). This decline in water levels is likely to result in a reduction of the groundwater contribution to both Lake Avalyn and Bluegill Pond.

An additional alteration to the shallow water table beneath the site will result from the Hold-up Basin. Because the Hold-up Basin will not be lined, it is likely that when the Hold-up Basin contains water at an elevation above the elevation of the shallow groundwater, groundwater mounding (localized recharge) will occur beneath it. Although this could be expected to contribute to water levels in Bluegill Pond, its impact would likely be minimal.

While the CEC facility is expected to alter the onsite shallow groundwater regime, these effects are likely to be limited to the onsite drainage basins and are not expected to extend beyond the boundaries of the property to any significant degree.

As discussed in Section 2.5.2.3.1, the elevation of the shallow groundwater beneath the site generally follows the surface topography and it is likely that during much of the year shallow groundwater discharges to surface water bodies. Because surface water bodies are located prior to and along the eastern, southwestern, and northwestern property boundaries, the effect of the reduced recharge to the groundwater is not likely to extend beyond these discharge points. However, a slight decrease in the elevation of the water table may be observed along the north-northeast, west central and south-southeast property boundaries where streams are not present. Effects in these directions are expected to diminish with increased distance from the facility. The reduction in recharge on the property does not have the potential to adversely impact domestic production of groundwater from shallow wells in the vicinity of the site due to their location and depth with respect to the CEC facility.

The withdrawal of groundwater from the Sparta Aquifer by the CEC facility was evaluated in Section 2.5.2.4. Using conservative assumptions it was determined that continuous withdrawal of groundwater at a rate of 50 gallons per minute (gpm) would result in a 4.3 foot decrease in the potentiometric surface of the Sparta beneath the southern property boundary, and less than 25%, or 3 feet, of the total drawdown observed at the closest neighboring well in the Sparta Aquifer (Central Claiborne Water System Well #4). However, over the time period evaluated (30 years) additional declines of 10 to 30 feet are likely to be observed in the potentiometric head of the Sparta in the vicinity of the facility due to large regional pumping centers in northern Louisiana and southern Arkansas.

Therefore, the effects of groundwater withdrawal from the Sparta Aquifer by the facility are expected to be negligible when compared to the effects due to large regional withdrawals.

4.1.2.3 Effects on Aquatic Life

Clearing and grading during construction of the CEC facility could result in increases in erosion and sediment transport to Bluegill Pond, Lake Avalyn, and the small streams that drain the site. However, an erosion control plan will be developed and implemented prior to clearing activities associated with construction of the facility. Therefore, the amount of soil that is transported from the construction site is likely to be minimal. Slight increases in turbidity and siltation potentially associated with any minimal erosion are unlikely to impact aquatic life in receiving waters, although high levels of turbidity and siltation can affect growth, reproduction, and survival of aquatic species.

The excavation of the Hold-Up Basin will result in the creation of 3 acres of new surface water habitat just north of Bluegill Pond. Because the Hold-Up Basin will be closed from all natural surface water systems at the site (i.e., it will not receive surface water inputs from these natural systems), aquatic life present in onsite surface water will not disperse to the Hold-Up Basin. Consequently, the aquatic life in the Hold-Up Basin will most likely be limited to mobile species, such as insects and amphibians, which live and/or breed in surface water. Some small invertebrate species (such as amphipods and decapods) currently present in other onsite surface waters could be transported to the Hold-Up Basin if eggs of these species adhered to wildlife (e.g., frogs, birds) and were deposited in the Hold-Up Basin. Zooplankton and phytoplankton could be similarly transported to the Hold-Up Basin.

4.1.2.4 Effects on Terrestrial Vegetation and Wildlife

Water use by terrestrial wildlife and plants is not likely to be impacted by construction of the CEC facility. The availability of surface water, which is used by some wildlife species as a source of drinking water, will not be affected by site construction, and any small increases in surface water turbidity associated with construction is unlikely to affect surface water use by terrestrial wildlife. As noted in Section 4.1.2.2, the local water table is likely to decline beneath the facility and the groundwater divide will shift to the east and southeast as a result of facility construction. However it is unlikely that the elevation of the water table in discharge areas (e.g., streams, lakes and wetlands) will be affected by these changes and an impact on vegetation in these areas is not anticipated. Creation of the Hold-Up Basin will result in an additional drinking water source for terrestrial wildlife species and additional breeding habitat for some amphibian species. However, under baseline conditions, neither of these resources is in short supply on the CEC site.

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Table 4.1-1
CEC Construction & Operation Schedule

ITEM	Plant Unit 1	Plant Unit 2	Plant Unit 3
Receive Construction/ Operation Permit	2/93	2/93	2/93
Break Ground	2/93	2/93	2/93
Start Concrete Foundation	7/93	7/93	7/93
Receive Centrifuge Machine Parts	7/94	3/95	12/95
Start Installation of Centrifuge Machines	4/95	12/95	9/96
Receipt of UF6	8/95	4/96	1/97
Production begins as cascades are brought on-line individually	9/95	6/96	3/97
Commercial Operation at Full Production Output	7/96	4/97	12/97

Year	Average Construction Employment	Average Operation Employment
1993	50	40
1994	200	100
1995	400	180
1996	400	180
1997	100	180
1998	0	180

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

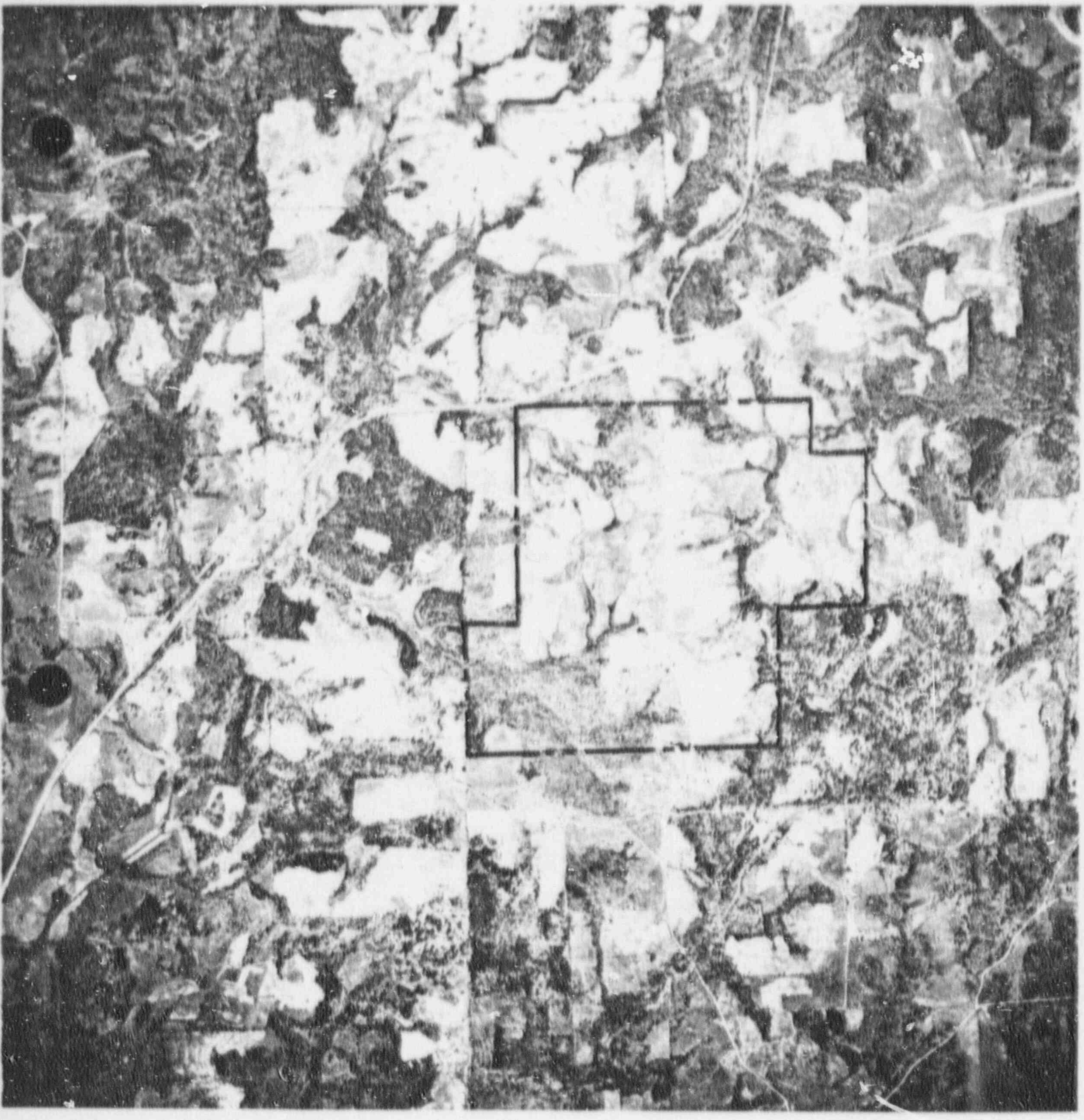
Construction/Operation Manpower Requirements

Table 4.1-2

Table 4.1-3

Earthwork Volumes

Facility Yard (Controlled Area)	400,305 cubic yards fill 405,749 cubic yards excavation
Hold-Up Basin	28,000 cubic yards fill



SCALE: 1" = APPROX. 1770'

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

CEC Site
Aerial Photo
1950

Figure 4.1-1

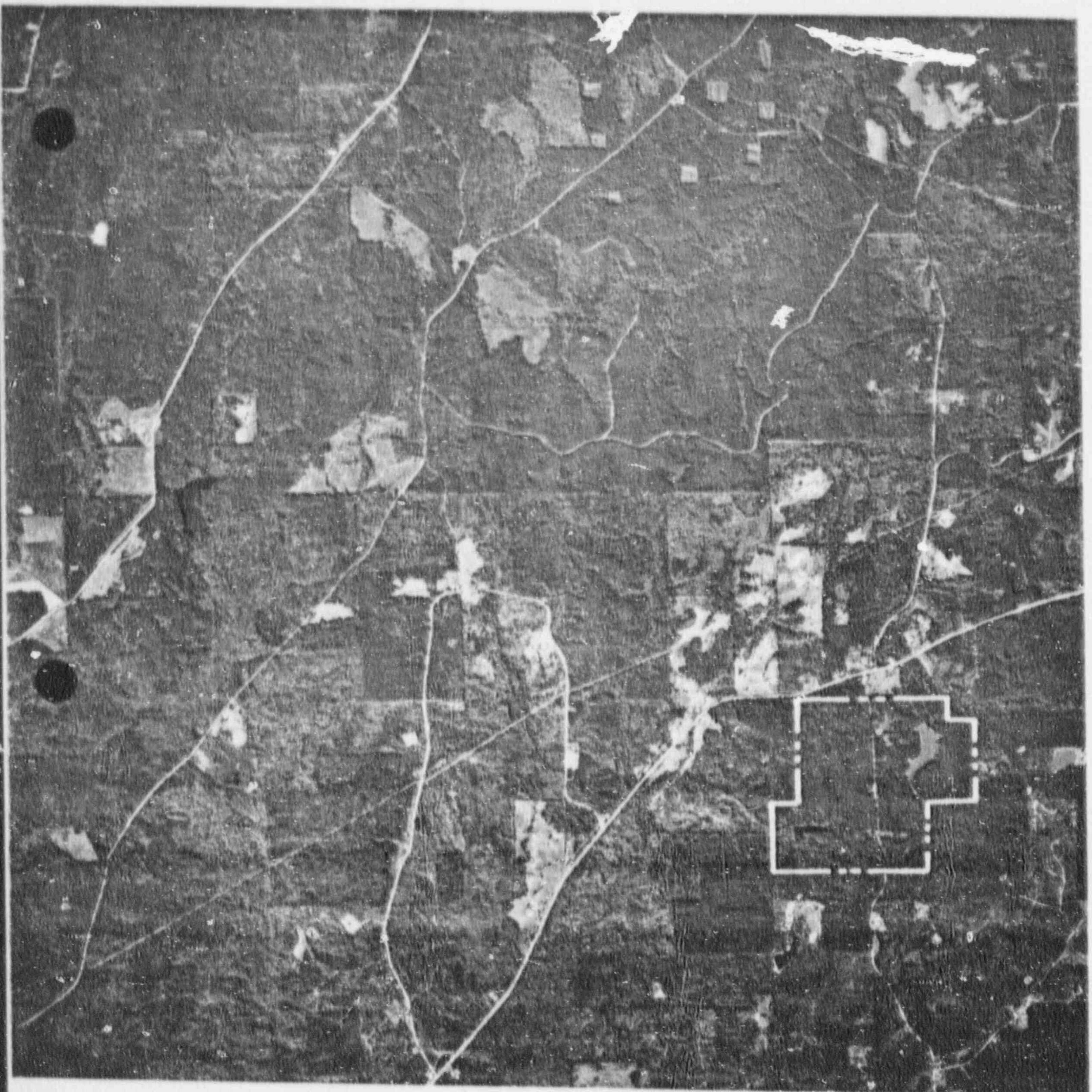
SCALE: 1" = APPROX. 1660'

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

CEC Site
Aerial Photo
1955

Figure 4.1-2



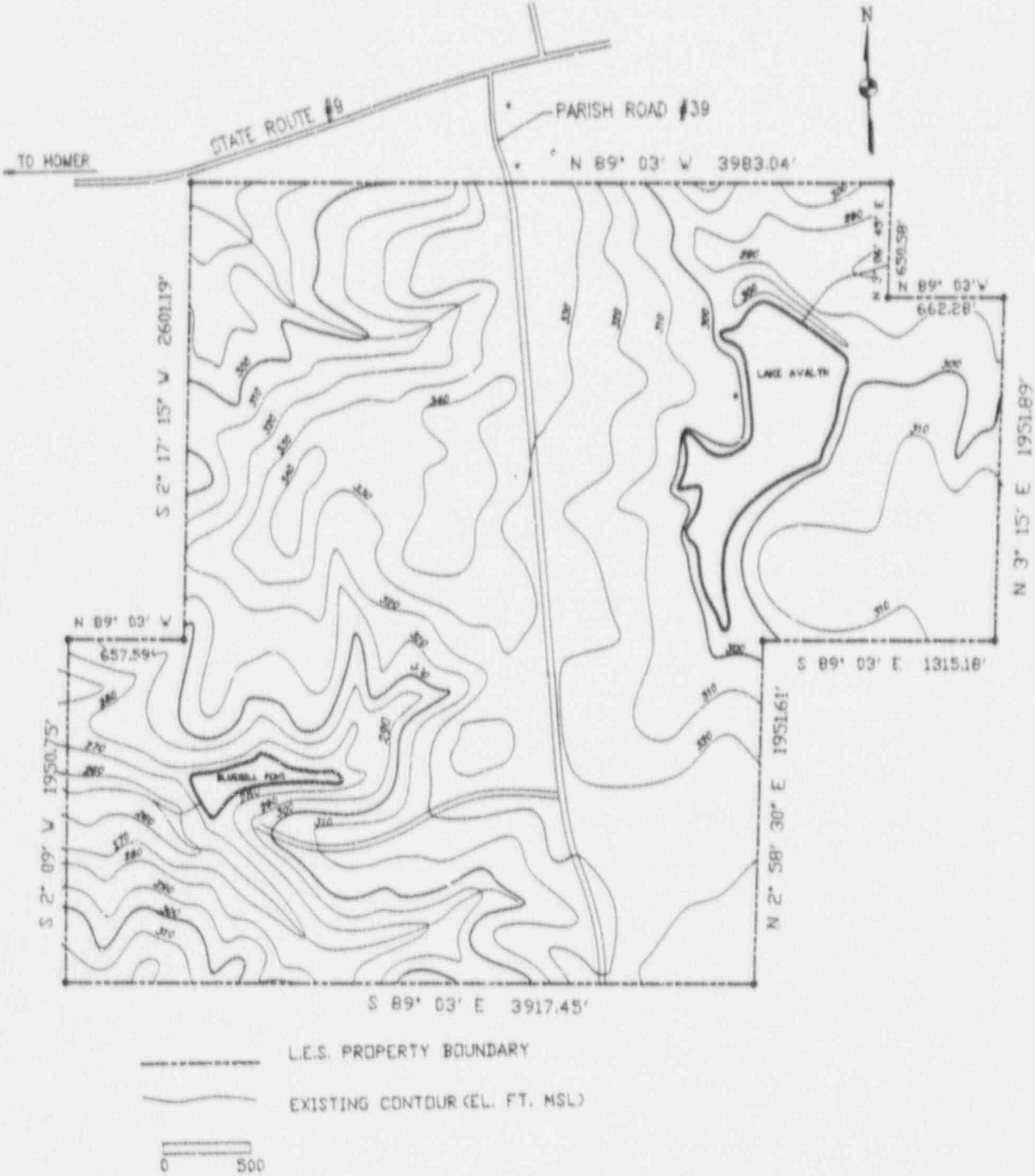
SCALE: 1" = APPROX. 3525'

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

CEC Site
Aerial Photo
1978

Figure 4.1-3

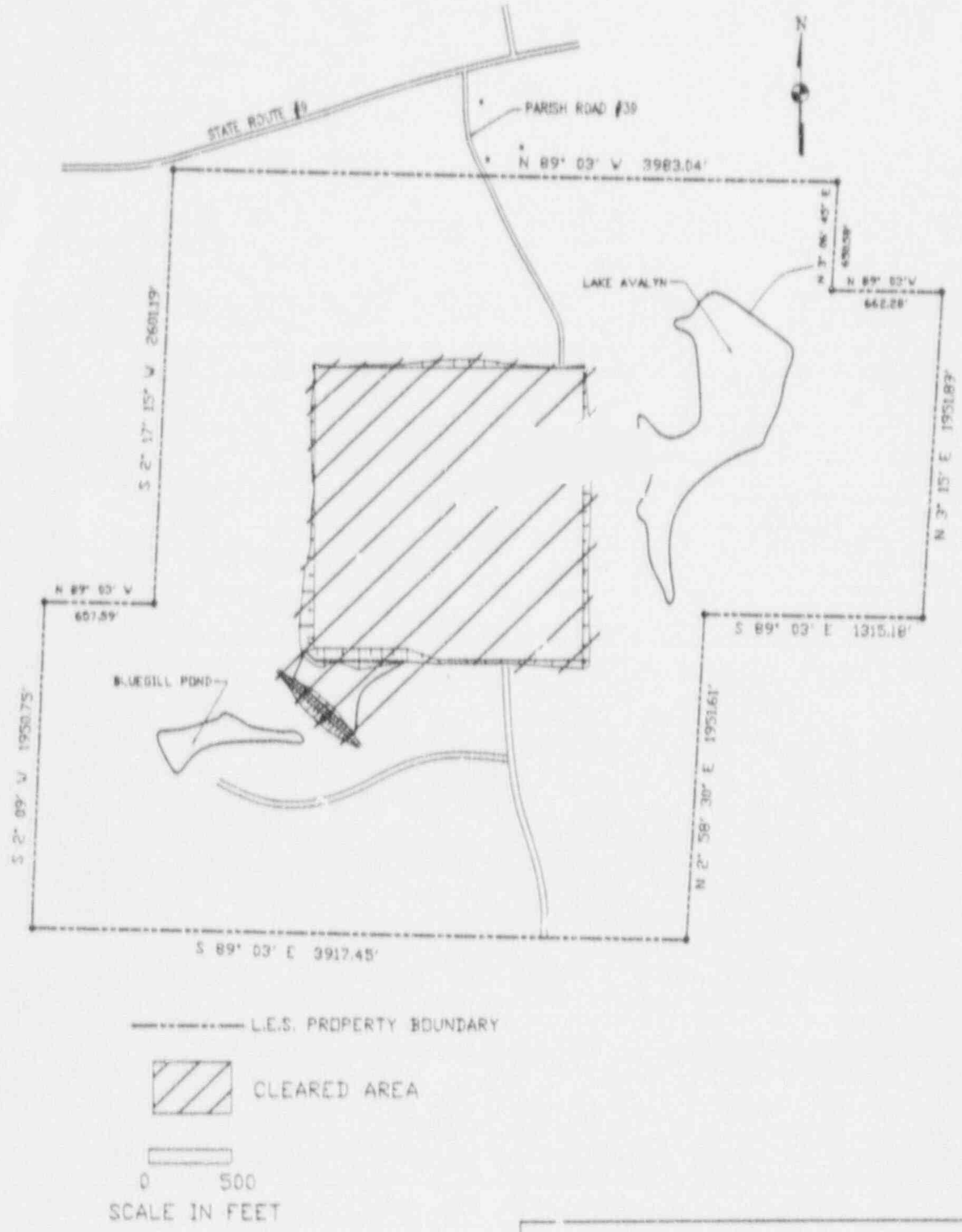


LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

CEC
Site Topography

Figure 4.1-4



LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

Cleared Construction Area

Figure 4.1-5

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4.2 EFFECTS OF PLANT OPERATION

This section describes the effects of plant operation on the environment surrounding the CEC facility.

4.2.1 EFFECTS OF IONIZING RADIATION

Radionuclides in the environment can be divided into four groups according to their origin: 1) nuclides that existed or were created during the formation of the earth and have a sufficiently long half-life to be detected today; 2) nuclides created by the decay of the primordial radionuclides; 3) nuclides continually produced by natural processes other than the decay of the primordial nuclides; and 4) nuclides produced during human activities. The identities and activity levels of these radionuclides can vary extensively around the world, with variations seen between areas in close proximity. The first three groups constitute the major source of radiation exposure to people (References 1,2,3,4). The extent of radionuclides and radiation levels in any given area can be influenced by such factors as geology, precipitation, runoff, disturbances of the topsoil layer, solar activity, barometric pressure, and a host of other variables. Exposure to natural background radiation and radioactivity in the United States varies over a range from 100 to 250 mrem per year whole body dose equivalent, depending on the geographic region or locale.

Technological developments have added to the radiation dose received (primarily medical exposures) and to the inventory of radioactive materials, both atmospherically and terrestrially (primarily fallout). It is important that the added radioactive materials due to technological developments be monitored and limited. In order to assess the Claiborne Parish, Louisiana, site conditions prior to initiation of the preoperational radiological environmental monitoring program, an assortment of samples were taken within the site boundaries. A summary of the sample types, locations, and data obtained from the analyses is presented in a Section 6.1.5.1.

Because public confidence in the safety of the facility is of paramount importance, the radiological environmental monitoring programs have been designed to provide comprehensive data to demonstrate that the facility is not adversely impacting the environment. Strategies have been developed to determine the most appropriate form of sampling for the specific media that will be identified in Sections 6.1.5 and 6.2.1.

To estimate the effective committed dose equivalents by releases to plant environs, comparisons will be performed between the actual and maximum allowable releases. This information will permit proper appraisal of the radiological impact of plant operation. The comparative analyses for both liquid and gaseous pathways will use limits obtained from the Code of Federal Regulations, Title 10, Part 20 (Reference 5), projected release data, and enrichment plant specifications. The comparisons will yield data that will demonstrate sufficient protection to the general public, even when releases of radioactive materials are assumed. Calculated doses will be shown to have little statistical significance. A program for monitoring appropriate pathways will be presented, which will ensure that the radiological impact of the facility remains negligible.

A discussion of important exposure pathways, dose calculations, and radiological environmental monitoring is presented in the following sections.

4.2.1.1 Liquid Effluents

A discussion of the liquid pathway and its associated variables is presented in the following text. Estimates of dose and assumptions used are also calculated and shown.

4.2.1.1.1 Critical Nuclide

Liquid effluents are expected to be a secondary mode of dose to the public and are anticipated to contain minute quantities of uranium compounds and uranium daughter products. Since the half-life of uranium is quite long, resulting in very limited production of daughter nuclides, the focus of liquid pathway sampling will be on uranium, of which uranium-238 is by far the most abundant isotope, and its interaction with the environment. Uranium-235 and uranium-234 are also expected to be present in effluents and will be quantified as well. Daughter products are expected to be present in plant effluents and these radionuclides will be quantified as they are detected. Calculations indicate that secular equilibrium will be reached with the first uranium-238 daughter (thorium-234) after approximately 250 days of release into the environment. This is followed by transient equilibrium between thorium-234 and its daughter protactinium-234 which decays to uranium-234 (half-life of 244,500 years) which will eventually decay to thorium-230 (half-life of 77000 years). Calculations also indicate that an overall equilibrium of uranium-238 through [illegible]nium-234 decay chain is reached after approximately 840 [illegible]. Overall equilibrium of the uranium-235 through actinium-22[illegible] chain is achieved after approximately 39 days.

Routine releases from the facility will contain minute activities of uranium-238, uranium-235, uranium-234 and their daughter products - all of which are expected to have an insignificant impact on the environment. This is substantiated by literature (Reference 3) that asserts that bioaccumulation of uranium nuclides is considered to be very small (factor approximately equals one) in the literature surveyed (Reference 3). Additionally, the same literature states that in more eutrophic environments, such as that found in the Claiborne Parish region, the bioaccumulation factor is even less than that found in non-eutrophic regions.

4.2.1.1.2 Liquid Pathway

The liquid pathway encompasses sample types such as ground water, surface water, and sediment which are described in subsequent sections and shown in Figure 4.2-1. Virtually no transport of uranium through soils is expected as determined by research (References 6 and 7) which shows that the ground water pathway of little or no radiological significance.

Surface and drinking water can be affected as the diluted effluent is transported to surface streams and lakes. Organisms dwelling in these aquatic environments will come in contact with the effluents that may or may not contain uranium. Since literature has documented that bioaccumulation values for uranium are near unity, the concentration of uranium in organisms is not of concern. The low quantities of released uranium coupled with the extensive dilution of the effluent by the Bluegill Pond (see Section 4.2.1.1.3) result in no significant radiological impact on any aqueous pathway.

The liquid pathway can also be impacted via airborne effluents. Gaseous releases could result in deposition of uranium on the roof and subsequent rain-induced washing of the particles into the roof drains and finally into the Hold-Up Basin. This is expected to be insignificant, but will be assessed in the environmental monitoring programs.

4.2.1.1.3 Plant Effluents - Liquid Routine Operation

Normal plant liquid effluents have been estimated to be 170,000 gallons/year (all process waste water discharged from the separation building). Under expected routine operation of the facility, these effluents are expected to contain very low levels of uranium-235 and uranium-238. Using a very conservative assumption that the effluent contains 90% of the 10 CFR Part 20, Appendix B limit for release into an unrestricted area, the total uranium activity in Bluegill Pond is estimated to be 1.3E-6 μCi/ml (see Table 4.2-1 for calculations). This assumes no additional dilution or release from Bluegill Pond. If 40 years of plant operation are assumed with the entire inventory of routine uranium effluent routed to Bluegill Pond, an approximate activity level of 5.2E-5 μCi/ml of uranium could accumulate over 40 years - a very insignificant activity level. Under routine operating conditions the actual activities in effluents are expected to be much lower than 90% of the 10 CFR Part 20 limit.

4.2.1.1.4 Dose Calculations - Liquid Pathway
Routine Operation and Accident Scenarios

Dose estimates (quantified below) using the uranium concentrations calculated in Table 4.2-1 show that the liquid pathway does not result in any significant committed effective dose equivalent (EDE) to members of the public. If the Bluegill Pond uranium concentration of 1.3E-6 µCi/ml is used in dose calculations to individuals that ingest one liter of Bluegill Pond's water, the whole body EDE is 3.3E-4 rem (3.3E-6 Sv) for the liquid pathway (see Table 4.2-4 for individual organ dose summary). This is extremely minute and will have no measurable adverse health effects on the receiving individual. Additionally, the water in Bluegill Pond is not used as a drinking water source, allowing for the extensive dilution of the uranium concentration in the ultimate destination of the pond's outflow - Lake Claiborne.

ICRP-30 (Reference 8) lists the dose factors for uranium-234, uranium-235 and uranium-238 and these values are listed in Table 4.2-2. The uranium radionuclides of lower abundance have similar dose factors as compared to uranium-238 that would not significantly impact the EDE over fifty years. Since uranium-238 is by far the most abundant nuclide in the uranium series, dose calculations will assume that it is 100% abundant. If the uranium-238, uranium-235 and uranium-234 abundances were added to the calculations, the EDE would be approximately the same as that calculated for uranium-238 using 100% abundance.

Examination of ICRP-30 data yields only three organs/tissues of interest (red bone marrow, bone surfaces, kidneys) for ingestion of soluble uranium-238 compounds. Five organs/tissues (red marrow, bone surfaces, upper large intestinal wall, lower large intestinal wall, kidneys) are shown to be affected by insoluble uranium-238 compounds. The most restrictive weighted dose factor in ICRP-30 for ingestion of uranium-238 is that of the bone surfaces (value of 3.0E-8 Sv/Bq = 3.0E-6 rem/Bq) for soluble compounds. Using this weighted dose factor, the calculated committed dose equivalent to the bone surfaces for ingestion of one liter of Bluegill Pond water containing 1.3E-6 µCi/ml of uranium equals 1.4E-4 rem. Doses to the two other tissues of interest, bone marrow and kidneys, are calculated to be 3.9E-5 rem and 1.2E-4 rem, respectively, under the same conditions as used for the bone surfaces. The sum of the three committed dose equivalents as calculated for ingestion of soluble forms of uranium-238 is 3.0E-4 rem. Calculation of a committed dose equivalent for the five organs/tissues listed for the uranium compounds of lower solubility results in a committed dose equivalent for all five organs/tissues of 3.0E-5 rem. Summing the committed dose equivalent values for both uranium-238 solubility classes results in a value of 3.3E-4 rem (.00033 rem), which is so insignificant and the probability of ingestion of undiluted Bluegill Pond water is so remote that the liquid pathway is of essentially no consequence radiologically under expected routine operations.

Plausible accident scenarios are primarily concerned with the gaseous pathway and realistically would not impact liquid effluents. The liquid pathway could be impacted via gaseous effluents, as released from roof vents, that precipitate on surfaces such as the roof and ground and are subsequently washed into the Hold-Up Basin or other receiving environments. For this reason, the Hold-Up Basin will also be sampled in the operational environmental radiological monitoring program. The doses received, if Hold-Up Basin water was ingested, are expected to be extremely low - values which will be calculated if an accident occurs resulting in gaseous discharges through the roof vents that exceed normal expected gaseous effluents by a factor of ten.

4.2.1.1.5 Plant Effluents - Liquid Comparison to 10CFR20 Appendix B

Reference 5 (Appendix B of 10 CFR Part 20) lists the release limits for uranium-238 as 4E-5 μCi/ml for unrestricted areas. Comparison of this limit to the example uranium concentrations used in Table 4.2-1 (uranium concentration of 90% of the 10 CFR Part 20 limit) above background in Bluegill Pond after dilution shows a difference between the limit of 4E-5 μCi/ml and the estimated diluted effluent concentration of 1.3E-6 μCi/ml uranium-238 - a safety factor of 30. When these comparisons are performed for uranium-235 and uranium-234, safety factors of 850 and 21500 are obtained. Therefore, the discharges into Bluegill Pond are well within regulatory limits. Additionally, these conservative calculations are based on effluent concentrations at 90% of the 10CFR20 limit and in reality, these concentrations are highly unlikely to occur.

4.2.1.2 Airborne Effluents

4.2.1.2.1 Critical Nuclide

Uranium-238 will be the critical nuclide for the gaseous pathway. See section 4.2.1.1.1 for text and calculations relating to determination of the critical nuclide.

4.2.1.2.2 Gaseous Pathway

Gaseous releases from the facility will be the primary mode for potential dose to the public. The gaseous pathway (illustrated in conjunction with the liquid pathway in Figure 4.2-1) encompasses sample types such as air, soil and surface water which are described in subsequent text. Strategies have been developed to determine the most appropriate form of sampling for the proper media type in the gaseous pathway. These data will provide information to calculate annual organ and whole body dose commitments, if any, to individuals and populations due to facility operation.

4.2.1.2.3 Plant Effluents - Gaseous Routine Operation

If process ventilation releases are estimated to be approximately 0.35 µCi (one gram) per year and Chi/Q values are used, then estimated concentrations of uranium can be determined. When utilizing the highest annual Chi/Q value derived for the site (3.19E-7 s/m3 for maximum offsite Chi/Q in the direction of prevailing wind), a value of 3E-15 µCi/m3 (3E-21 µCi/ml) for averaged routine releases can be derived. When this value is compared to the 10 CFR Part 20, Appendix B limit for an unrestricted area (most restrictive is 3E-12 µCi/ml for uranium-238), it is quite apparent that routine releases will not result in concentrations that approach the 10 CFR Part 20 limit. This also assumes relatively little deposition on site which would lower the concentration found in unrestricted areas to an even greater extent.

In order to further illustrate that the gaseous effluents are well within 10 CFR Part 20 limits, if the release was doubled to 0.70 µCi per year and dispersed in similar conditions as listed above, the resulting concentration would still not be close to the regulatory limit and not result in adverse affects to exposed individuals.

Chemical toxicity will be of the greater concern at smaller concentrations far beyond the radiological impact (Reference 9). When these routine maximum ventilation releases are compared to the LD50 of uranium (LD50 = 243 mg uranium inhaled by one person acutely), it is clear that a level of intake required to cause death would require one person to inhale and absorb about 25% of the maximum annual release at one time, accounting for no atmospheric dispersion.

Additionally, the total of maximum annual routine releases assume no atmospheric dispersion. Since it is highly unlikely that one person would be subject to such a dose, comparison of the maximum annual release to lower quantities of uranium-238 intake are more practical. Reference 8 documents that no adverse effects are observed after an acute inhalation of 4.5 mg of uranium nuclides. When the 4.5 mg is compared to the maximum daily mean release of 2.74 mg as calculated from an annual total release of 1 gram, then the affected individual would inhale 2.74 mg which is well below the level where no adverse effects are quantified.

Additionally, these adverse effects are due to chemical toxicity and not due to a radiological hazard.

4.2.1.2.4 Dose Calculations - Gaseous Pathway Routine Operation and Accident Scenarios

Reference 8 (ICRP-30) will be used as the primary dose factor reference. Release of uranium via the gaseous pathway can potentially result in an inhalation dose to individuals directly in the plume. If the uranium is present as uranium hexafluoride (UF_6) or as uranium oxides [UO_2F_2 and $UO_2(NO_3)_2$], then the compounds are rapidly absorbed by the lungs (ICRP-30 has assigned these compounds to inhalation class D with an $f1=0.05$). If the release is in the form of less soluble compounds (UO_3, UF_4, UCl_4) of ICRP-30 class W ($f1=0.05$) or in the form of very insoluble compounds (UO_2, U_3O_8) of ICRP-30 class Y ($f1=0.002$), then the resulting uptake by the lungs will be smaller. When the identity of the released compounds is not known, class Y will be assumed to utilize the highest dose factor to the lungs. If the identity of the released compounds is known, then the appropriate inhalation classes will be used in dose equivalent calculations.

ICRP-30 contains conversion factors that relate activity to dose as a function of the retention of the uranium-238 in the body (classes D, W, Y). If a routine release is estimated to contain 3E-15 µCi/m3 as calculated in Section 4.2.1.2.3, then the estimated annual weighted committed dose equivalent is calculated to be 3E-9 rem for the whole body (assumes standard man breathing 8000 m3 air/year). Other permutations of the release and inhalation will yield variations of this dose, but will still be very insignificant.

To further illustrate that routine gaseous releases will have no adverse effect on the environment and individuals near the discharge point, the entire gram (0.3 µCi) of uranium can be assumed to be released over a short period of time (i.e. 24 hours). If the release is inhaled over a period of 24 hours and assuming a standard man breathing rate, the same Chi/Q as above and no deposition, the calculated dose to the lungs is 1.1E-6 rem. This will have no adverse effect on the receiving individual.

Since the likelihood of routine releases causing adverse health effects are extremely small, attention is then turned to potential accidents. One scenario is the rupture of a cask and loss of its contents. The amount of uranium lost is primarily dependent upon the size and temperature of the cask and the effectiveness of the plant safeguards. Assuming that all of the contents of a cask are discharged into the atmosphere, a range of 0.6 Ci (5000 pound product cask) to 3.0 Ci (27,000 pound feed cask) may be released into the environment (see Table 4.2-3 for calculations). Employing the most restrictive Chi/Q value, assuming loss of all cask contents, using the weighted committed dose equivalent dose factor, and using a standard man breathing rate (8000 m3/year) over one hour - the estimated airborne concentration is 9.8 dps/m3 and the estimated dose to an offsite individual at the highest Chi/Q location is calculated to be 33 mrem for the whole body, of which the great majority of the dose is received by the lungs. These calculations do not allow any credit for engineered safeguards (passive or active) such as sprinklers which would trap a large majority of the release in the Separation Building, nor does it assume that exposed individuals will take action to protect themselves. This scenario is extremely unlikely, but does illustrate that even the discharge of the entire contents of a cask would not result in a radiation dose that exceeds the LD50. In this case, the chemical toxicity would be the limiting factor as to the seriousness of the accident. More realistic scenarios are described in Reference 9 and involve various variables in accidents.

Monitoring of the environment after such an accident could include soil, vegetation, and air in the vicinity of the accident to determine the amount of uranium remaining onsite and also transported offsite. It is not probable that a significant quantity of the uranium would be found in Lake Avalyn and analysis of lake surface water would not be expected to yield sufficient information as to the extent of the plume due to the dilution effect of the water. Reference 9 (NUREG 1140) is quite clear in maintaining the position that realistic circumstances must be considered when examining the probability of accidents and potential exposure of uranium to the general public. By far, the most likely condition of danger will be from the exposure to chemical hazards that may be produced during accidental releases to the atmosphere. The subsequent radiation dose is expected to be of little consequence in reasonable scenarios.

4.2.1.2.5 Plant Effluents - Gaseous Comparison to 10 CFR Part 20, Appendix B

Reference 5 (Appendix B of 10 CFR Part 20) lists the most conservative release limits for uranium-238 as 3E-12 μCi/ml (soluble form) for unrestricted areas. Comparison of this limit to the estimated gaseous effluent concentrations in section 4.2.1.2.3 shows a wide difference between the limit and the estimated concentration (3E-21 μCi/ml) in the area with the highest Chi/Q. Therefore, routine releases are expected to be well within the 10CFR20 limit. If the accident scenario is Section 4.2.1.2.4 is assumed using a breathing time of one hour for the entire contents of a feed cask, the estimated airborne concentration in the area with the highest Chi/Q is 2.7E-10 μCi/ml - above the limit, but of little consequence from a radiological dose perspective.

4.2.1.3 Summary of Radiation Dose Commitments

Dose projections for the enrichment facility have assumed maximum release conditions during routine operation of the plant. The operating nature of this facility, based upon actual history of similar facilities in Europe, results in extremely low activities of radioactive effluents which are not likely to adversely affect the environment. As indicated with dose calculations derived from the liquid and gaseous pathways, the maximum effluent doses are so small that no statistical significance can be shown from these most probable release paths.

The most affected individual would receive approximately 3E-9 rem (3 one billionths of a rem) annually from routine plant operations via the gaseous pathway. This assumes that the same person would be impacted by the highest concentration of gaseous releases. Calculations for the liquid pathway have been performed using a scenario that employs ingestion of Bluegill Pond water - a highly unlikely occurrence. This was done to demonstrate that even with ingestion of Bluegill Pond water, the associated doses are very small. Realistic assumptions would reduce this dose significantly due to dilution with waters that are encountered downstream from the facility, including Lake Claiborne. Therefore, the realistic dose from the aqueous pathway would be approximately 1E6 lower (no higher than 3E-10 rem per individual) from Lake Claiborne dilution alone. The sum of the EDE for both pathways is approximately 3.3E-9 rem and is shown in Table 4.2-4. This can be compared to the 0.01 rem EDE received from a standard chest X-ray and put in terms of receiving one chest X-ray equates to being the most exposed individual from the facility for over three million years.

Additionally, if releases and/or environmental data are orders of magnitude different from the assumptions used, there would be no change in the conclusion regarding the insignificant effect of facility effluents. For example, if the releases for liquid and gaseous were one hundred times larger than the values used in previous calculations, the resulting total EDE for the most exposed individual would be approximately 3E-7 rem.

Dose commitments calculated for individuals at other less affected locations are not reasonable since impact from the radiological effluents will be of no significance to the general public. Therefore, it is not necessary to calculate dose commitments for individuals at the plant boundary, within five miles of the plant, etc. since all of these calculations will yield an annual EDE of less than 3E-9 rem (3 one billionths) whole body. A tabular summary of committed dose equivalents for the highest exposed individual is presented in Table 4.2-4.

4.2.2 EFFECTS OF CHEMICAL DISCHARGES

4.2.2.1 Effects of Plant Operation on Receiving Water Quality

The design of the CEC is such that treated effluent will be discharged into Bluegill Pond. As discussed previously, outflow from the pond joins the stream from south of the property and flows off of the property to the west as a tributary to Cypress Creek and ultimately discharges into Lake Claiborne. Actual chemical discharge limits in the effluent have not yet been set by the State of Louisiana. The standards will be established under the National Pollutant Discharge Elimination System (NPDES) and, as such, will be specific to the facility. The waste treatment process at the facility will be designed to meet the NPDES standards at the point of effluent discharge.

Preliminary limits have been established for some parameters. Of the parameters with preliminary limits, concentrations of chlorides and sulfates in surface water, shallow groundwater, and groundwater from the Sparta Sand aquifer have been measured. Total suspended solids and pH, which also have preliminary limits, have been measured in some samples. A comparison of chemical measurements (see Tables 2.5 [1, 2, 4, 5, 6, 8, 15 & 16] in Section 2.5) with the limits indicates that for all of these waters, natural concentrations are below the preliminary regulatory limit of 50 ppm for chloride. All of those analyzed for pH are within the regulatory range of 6 to 8.5. The regulatory limit of 15 ppm of sulfate was exceeded in the groundwater sample collected on August 1, 1990 from the Central Claiborne Water System Well #4 (18 ppm). This indicates that the natural concentration of sulfate in the groundwater withdrawn by the facility may be close to the discharge limit before use. Additionally, concentrations of sulfate in the unfiltered samples from onsite wells B-2, C-1, and D-1 (39 ppm, 83 ppm, and 52 ppm, respectively) exceeded the discharge limit. The regulatory limit of 65 ppm of total suspended solids was exceeded in all of the unfiltered samples from the onsite wells. Concentrations of total suspended solids in these samples range from 116 ppm to 3,690 ppm. However, it should be noted that concentrations of chemicals in unfiltered samples are not representative of concentrations that would migrate in the groundwater and no filtered samples from shallow onsite wells contained concentrations in excess of preliminary regulatory limits.

As discussed in Section 2.5.1, Cypress Creek has been shown to seasonally fluctuate between flowing and non-flowing conditions. In addition, flow in the main tributary of Cypress Creek discharging from the CEC site (the outflow from Bluegill Pond) was observed to decrease an order of magnitude between winter and summer.

Streamflow measurements along Cypress Creek are used to estimate the potential for downstream dilution of the effluent. In this analysis, the effects of dilution of the effluent discharge by Bluegill Pond are conservatively disregarded. It is projected that 3 million gallons per year (0.013 ft^3/sec) of treated effluent will be discharged from the facility. Using a simple dilution model based on the July 1990 flow measurements summarized in Table 2.5-2, which are expected to represent relative low-flow conditions, original effluent concentrations would be diluted over one order of magnitude prior to reaching the western property boundary, almost two orders of magnitude at 1.5 mi downstream, and over two orders of magnitude at 2.5 mi downstream. During average and maximum streamflow periods, effluent concentrations could be expected to decline an additional order of magnitude at each of these locations.

As discussed in Section 2.5.1.3, during extended periods of low precipitation (most likely in July and/or August) groundwater may fail to support baseflow in Cypress Creek reducing the stream to standing pools of water isolated by reaches of dry bed. Under these conditions, effluent discharges into Bluegill Pond and subsequently out of the pond in a diluted state would be expected to eventually infiltrate to groundwater. Upon reaching groundwater, further dilution would occur and flow would continue in the subsurface of the stream's floodplain.

4.2.2.2 Effects of Chemical Discharges on Groudwater

As discussed in previous sections, there is a close interaction between surface water and shallow groundwater. Therefore, even though treated effluent from the facility is discharged to surface water, under some low flow conditions this water may seep into groundwater. Although NPDES limits have not been established, the facility will be meeting limitations on chemical discharges prior to release and Bluegill Pond will provide additional dilution. Therefore, there is not likely to be an adverse impact on the groundwater quality.

4.2.2.3 Effects on Aquatic Life

The potential for aquatic life impacts is limited to Bluegill Pond and the small surface stream that flows from it. This pond will be the discharge point for liquid effluent from the entire plant. No other onsite or offsite surface waters will receive liquid effluent from the plant.

Liquid effluent from the plant will consist of treated and non-treated waters. Treated waters will be comprised of monitored and treated waste water from the sewage treatment system, which receives effluent from sanitary drains and from the Liquid Waste Disposal System.

Non-treated waters will be comprised of:

a. yard drains from all areas inside the security fence;

b. roof drains from the Office Building;

c. roof and floor drains from the Centrifuge Assembly Building;

d. roof and floor drains from the Container Receipt and Dispatch Building;

e. roof drains from the Separations Buildings;

f.) roof and floor drains from Pump House; and

g. roof and floor drains from Standby Generating Building.

Treated waters will be discharged directly to Bluegill Pond. Non-treated waters will first be routed to the Hold-Up Basin and then released to Bluegill Pond.

Chemicals that may be processed through the plant's Liquid Waste Disposal System are listed in Table 4.2-5. These consist of hydrocarbon oil, decontamination system chemicals (e.g., citric acid, potassium hydroxide), solvents (e.g., Freon TF), detergents, laboratory chemicals (e.g., carbon tetrachloride), and cooling water chemicals (e.g., biocides). Chemicals that may be present in effluent not processed through this system and that, therefore, may be present in non-treated waters released to the Hold-Up Basin include water treatment chemicals (e.g., chlorine) and possibly hydrocarbon oil.

The plant's Liquid Waste Disposal System is designed so that any wastestreams that have a significant possibility of exceeding release limits during normal plant operation are monitored, and treated if necessary to meet all release limits, before being transferred to the Liquid Waste Disposal System and eventually to Bluegill Pond. (See Section 3.0 for a complete description of all waste disposal systems.) The system is designed so that no hazardous wastes or hazardous chemicals will be present in liquid effluent released to Bluegill Pond. Although not monitored or treated prior to release to the Hold-Up Basin, nontreated waters released to Bluegill Pond from the Hold-Up Basin will be sampled monthly and anlayzed quarterly for gross alpha and beta radiation. Effluent water quality and NPDES limits will be established in cooperation with the Louisiana Department of Environmental Quality. If a release exceeds established limits, the release of effluent from the Holdup Basin will be stopped and the problem will be investigated, documented, and corrected immediately.

Given the Liquid Waste Disposal System's design coupled with the facility's committment to maintain all chemical release concentrations to levels below regulatory limits deemed to be protective of natural environmental components, it is unlikely that any hazardous wastes or hazardous chemicals will be released to Bluegill Pond. Further, given the proposed monitoring system for the Hold-Up Basin, it is unlikely that nontreated effluent that exceeds water quality parameters will be released to Bluegill Pond in significant quantities or for significant periods of time. Therefore, aquatic life at the site should not be impacted by chemical releases.

4.2.2.4 Effects on Terrestrial Plants and Wildlife

Because it is unlikely that hazardous wastes or hazardous chemicals will be released to the Hold-Up Basin or that effluent that exceeds water quality parameters will be released to Bluegill Pond in significant quantities or for significant periods of time, terrestrial wildlife using Bluegill Pond are unlikely to be impacted by chemical releases to surface water. Food-chain exposures resulting from the bioaccumulation of chemicals that have been released to the pond in small quantities are unlikely because, as mentioned above, none of the chemicals potentially released accumulates appreciably in aquatic life.

Because all air emissions will be maintained at or below levels established by state and federal regulatory agencies as protective of human health and the natural environment, no impacts on terrestrial plants or wildlife are likely to result from airborne releases.

4.2.2.5 Effects on Ambient Air Quality

Two main sources of air emission have been identified for the facility. During the 18 months of construction, it is anticipated that Freon 113 vapors will be released at an estimated rate of 400 kg/year from the Centrifuge Assembly Building, where the chemical will be in use as a solvent. During operation of the facility, the Separations Building will be ventilated at a rate of 200,000 cfm. The projected uranium content of the exhausted air is less than 1 g/year. It is also likely that the process ventilation will contain a small amount of fluorine and associated compounds. Uranium is regulated as a radioactive isotope, and Freon 113 may be subject to regulations governing the emissions of chlorofluorocarbons (CFCs).

No data are available for background levels of the above noted chemicals in the ambient air in Northern Louisiana. Consequently, the incremental impact of facility air emissions on ambient air quality cannot be determined specifically for each chemical in the emissions. Ambient air quality data in northern

Louisiana, however, were identified for criteria air pollutants. The data are presented and discussed in detail in 2.6.2. Examination of these data revealed that ambient levels of criteria air pollutants in Northern Louisiana have consistently met both the primary and secondary NAAQS by comfortable margins. Therefore, the air quality in Northern Louisiana can be characterized as very good.

4.2.2.6 Potential for Air Pollution in Northern Louisiana

Although the lack of background data for the chemicals emitted to the air by the facility makes it difficult to assess the impacts of plant emissions on ambient air quality, it is possible to undertake a general examination of the potential for air pollution in the region near the facility based on the potential of climatic conditions in the region for the long-term, large-scale dispersion of air pollutants. The remainder of this section is devoted to a discussion of this potential.

The potential for urban-scale air pollution events is largely governed by two meteorological variables, the height of the daytime mixing layer and wind speed. In the classic box model of urban air pollution, the mixing height is the height of the "box" through which relatively vigorous vertical mixing occurs, and the wind speed represents the rate at which pollutants are flushed from the box. For purposes of assessing the potential for urban air pollution across the contiguous United States, Holzworth calculated mixing heights and vertically averaged wind speeds from surface and upper air data collected at 62 National Weather Service (NWS) stations (Reference 10). Average wind speeds averaged through the mixing layer and mixing heights calculated by Holzworth for the Shreveport, Louisiana station are presented in Table 4.2-6. Both annual and seasonal averages are presented for the morning and afternoon mixing layers.

The morning mixing height was calculated as the height above ground at which the dry adiabatic extension of the morning minimum surface temperature plus 5 C intersected the vertical temperature profile observed at 1200 Greenwich Median Time (GMT). The afternoon mixing height was calculated in the same manner, except that the maximum afternoon surface temperature was used in place of the minimum morning surface temperature. The "plus 5 C" was used by Holzworth to account roughly for urban heat island effects. The Homer area is more appropriately characterized as rural and therefore not subject to urban heat island effects. The urban mixing heights for Shreveport calculated by Holzworth and presented in Table 4.2-6 are likely lower than the average mixing heights found in the Homer vicinity.

Three situations existed in which mixing heights could not be calculated in the prescribed manner:

a. when cold air advection was significant enough to result in the maximum afternoon surface temperature being less than the surface temperature at 1200 GMT,

b. during periods of significant precipitation when the assumption of a dry adiabatic lapse rate is questionable, and

c. much less frequently, in cases of missing data.

These situations occur for less than 20% of the year; mixing heights during these periods were incorporated into the averages using assumptions described by Holzworth (Reference 10).

The mixing heights listed in Table 4.2-6 are fairly representative of the mixing heights found at points which are 200 to 300 mi. inland from the Gulf and Atlantic coasts. Mixing heights in these regions are intermediary between coastal regions where mixing heights are relatively constant throughout the day (with annual average morning mixing heights typically around 800 m and afternoon mixing heights around 1000 m) and regions well within the interior of the continental United States, where the afternoon mixing height can typically be greater than the morning mixing height by a factor of 10 or more. Consequently, Northern Louisiana can be somewhat buffered from radiation inversions by the moist coastal climate.

Restricted dispersion and hence high levels of air pollutants result from the combined effect of low mixing heights and light winds. Holzworth made tabulations of episodes during which specified meteorological conditions were satisfied at each of 52 upper air NWS stations (Reference 10). Specifically, tabulations were made of episodes, over a 5-year period, lasting at least 2 days and episodes lasting at least 5 days with no precipitation cases and upper limits on mixing height and wind speed. The results for the Shreveport station are presented in matrix format in Tables 4.2-7 and 4.2-8. Holzworth reports that the relative severity of the various mixing height and wind speed limit combinations can be ranked roughly by the reciprocal of the product of the wind speed and mixing height. This is in fact the proportionality relationship of the mixing height and wind speed with the concentration in the box. Table 4.2-9 presents the ranking of mixing height and wind speed combinations using this method. Comparing Tables 4.2-7, 4.2-8, and 4.2-9 reveals that Shreveport experienced 2-day episodes in only the 5 least severe combinations and 5-day episodes in only the 2 least severe combinations. Tables 4.2-7, 4.2-8 and 4.2-9 also reveal, that relative to other areas of the United States, particularly the west coast, episodes of high meteorological potential for air pollution occur infrequently in Shreveport.

4.2.3 EFFECTS OF OPERATION OF HEAT DISSIPATION SYSTEM

All excess heat generated by the CEC facility processes and HVAC systems is rejected directly to the atmosphere via air-cooled chiller units. No waste heat will be dissipated into the environment through any of the facilities liquid effluents.

4.2.3.1 Effluent Limitations and Water Quality

The criterion for temperature in fresh water bodies established under the Louisiana Administrative Code (LAC):IX, Water Quality Regulation (Reference 11), consists of two parts, a temperature differential and a maximum temperature. The temperature differential, as stated in the regulation, represents the maximum permissible increase above ambient conditions after mixing. The numerical criteria for temperature specifies a maximum limit of 2.8 C (5 F) rise above ambient streams and rivers, or 1.7 C (3 F) rise above ambient for lakes and reservoirs. The maximum allowable temperature is 32.2 C (90 F); however, the limit can vary to allow for the effects of natural conditions, such as unusually hot, dry weather. Regional water bodies identified with numerical criteria, which would be representative of the conditions at the site, are Lake Claiborne and D'Arbonne Lake, with a maximum limit of 32 C (89.4 F). Therefore, the applicable maximum temperature limit is 32 C (89.4 F). There is expected to be no significant impact on the ambient water temperatures from the main cooling water system used during CEC plant processes. All heat generated from these closed-loop cooling water systems is rejected to the atmosphere (see SAR 6.4.6).

4.2.3.2 Physical Effects

There will be no thermal impact to either onsite or offsite receiving waters resulting from the operation of the LES facility since the process will not employ any liquid heat dissipation processes.

4.2.3.3 Biological Effects

No liquid effluent will be discharged from the facility which would increase the temperatures of receiving waters above state or federal regulations. Therefore, no thermal impacts on aquatic life will occur. Heat exchange with the atmosphere from plant air conditioning and machine cooling systems is not expected to significantly alter the local climate. Temperature changes in the atmospheric microclimate surrounding these units are unlikely to negatively affect any airborne wildlife (e.g., birds, insects) that are exposed to elevated temperatures during flight since exposure periods are likely to be very brief (e.g., a few seconds). Prolonged exposure periods which could alter physiological processes and/or behavior are unlikely because only a very small volume of air (i.e., that immediately surrounding the heat dissipation units) is likely to have elevated temperatures.

4.2.3.4 Effects of Heat Dissipation Facilities

All excess heat generated by the CEC processes and HVAC systems is either directly transferred to the atmosphere or indirectly to other closed-loop cooling water circuits. The Main Plant Cooling Water System comprises three closed-loop cooling water systems which discharge excess plant heat to the atmosphere through air-cooled chillers. Each plant unit (cascade) contains its own Main Plant Cooling Water System.

Based upon the number and size of all the facility cooling systems no on or off site meteorological changes such as fogging, icing, precipitation modifications or humidity shall occur.

The relatively small quantities of groundwater which will be used by the facility (i.e., 5-7 gpm average) will not adversely impact either groundwater levels of the Sparta Aquifer or its quality.

4.2.4 EFFECTS OF SANITARY AND OTHER WASTE DISCHARGES

The sewage treatment system for the CEC is described in Section 6.4.7 of the Safety Analysis Report (SAR). The input to the system is raw sanitary sewage from several different plant areas. The output effluent from the system is treated water that meets all state and federal regulations for release to the environment. Solid or sludge wastes which accumulate in the sewage system are monitored for radioactivity and disposed of in a local sanitary land fill. Proper operation of the system will ensure that no adverse environmental impacts will occur.

4.2.5 OTHER EFFECTS

Inception of the facility operation shall institute no changes in water or land use in the area of the facility which have not already been abrogated during the construction period or which would otherwise adversely impact the natural environment.

No interaction between gaseous and liquid effluents from the facility with other local or regional commercial or industrial facilities shall occur. In addition, there are no other wastes from the facility known at this time to be discharged or disposed of by means other than those already presented.

The effect of groundwater withdrawal by the CEC from the Sparta Aquifer, addressed in detail in Section 2.5.2.4, does not impact the ability of current users of the aquifer to withdraw water.

REFERENCES FOR SECTION 4.2

1. International Commission of Radiological Protection, "Radionuclide Release into the Environment: Assessment of Doses to Man," ICRP Publication 29, 1978

2. National Council on Radiation Protection and Measurement, "Natural Background Radiation in the United States," NCRP Report Number 45, 1975

3. Kathren, R. L., "Radioactivity in the Environment: Sources, Distribution, and Surveillance," Harwood Academic Publishers, 1984

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5. Code of Federal Regulations, Title 10, Part 20, "Standards for Protection Against Radiation"

6. Meriwether, et al., "Radionuclides in Louisiana Soils," Journal of Environmental Quality 74, Number 4, October-December 1988

7. Burns, et al., "Thorium, Uranium, and Cesium-137 in Louisiana Soils: Migration Trends in a Soil Catena Near Dubach, Louisiana," Radiochimica Acta, accepted February 1990

8. International Commission of Radiological Protection, "Limits for Intakes of Radionuclides by Workers," ICRP Publication 30, 1980-1988

9. U.S. Nuclear Regulatory Commission, "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees - Final Report," NUREG 1140, January 1988

10. Holzworth, G.C., Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States. Environmental Protection Agency, Office of Air Programs, Research Triangle Park, North Carolina, 1972.

11. Louisiana Administrative Code. 1989. Title 33. Environmental Quality. Part IX. Water Quality Regulations. Chapter 11. Louisiana Surface Water Quality Standards. Final Rule.

TABLE 4.2-1

CALCULATION OF BLUEGILL POND URANIUM CONCENTRATION

Assume activity per liter of effluent to be 90% of 10CFR20 Appendix B administrative limit for an unrestricted area.

10CFR20 Limits are as follows:

Abundance Nuclide Enrichment	Limit (μCi/ml)	90% Limit (μCi/ml)	Estimated After
U-238	4E-5	3.6E-5	0.9636
U-235	3E-5	2.7E-5	0.0350
U-234	3E-5	2.7E-5	0.0014

Assume annual effluent volume to be 170,000 gallons (6.43E8 ml)

Assume volume of Bluegill Pond = 14 acre-feet = 1.73E10 ml

Calculate activities of nuclides in releases of 170,000 gallons containing 90% of the administrative 10CFR20 limit and adjust for the estimated abundance of the nuclides after enrichment.

Nuclide	Concentration in Pond (μCi/ml)
U-238	1.3E-6
U-235	3.5E-8
U-234	1.4E-9
SUM	1.3E-6

Therefore, uranium concentrations in the pond are estimated to be

1.3E-6 μCi/ml.

TABLE 4.2-2

ICRP-30 WEIGHTED COMMITTED DOSE EQUIVALENT FACTORS PER INTAKE OF UNIT ACTIVITY (SV/BQ) OF URANIUM-238, -235 AND -234

ORAL		INHALATION		
SOLUBLE f(1)=5E-2	INSOLUBLE f(1)=2E-3	CLASS D f(1)=5E-2	CLASS W f(1)=5E-2	CLASS Y f(1)=2E-3
R MARROW	R MARROW	R MARROW	LUNGS	LUNGS
8.2E-9	3.3E-10	7.9E-8	1.7E-6	3.2E-5
8.2E-9	3.3E-10	7.9E-8	1.8E-6	3.3E-5
8.7E-9	3.5E-10	8.4E-8	1.9E-6	3.6E-5
BONE SURF	BONE SURF	LUNGS		
3.0E-8	1.2E-9	3.4E-8		
3.1E-8	1.3E-9	3.5E-8		
3.4E-8	1.4E-9	3.8[illegible]-8		
KIDNEYS	ULI WALL	[illegible] SURF		
2.5E-8	8.7E-10	2.[illegible]-7		
2.6E-8	1.0E-9	3.0E-7		
2.8E-8	9.7E-10	3.3E-7		
LLI WALL	LLI WALL	KIDNEYS		
none	2.7E-9	2.4E-7		
3.2E-9	3.2E-9	2.5E-7		
none	3.0E-9	2.7E-7		
	KIDNEYS			
	1.0E-9			
	1.0E-9			
	1.1E-9			

NOTE: The first value listed for each dose factor is for uranium-238, the second dose factor is for uranium-235 and the third dose factor is for uranium-234.

TABLE 4.2-3

URANIUM INVENTORY CALCULATIONS USED IN COMMITTED DOSE EQUIVALENT CALCULATIONS

Note: Accident scenarios assume loss of 100% of contents - this is highly unlikely, but the calculations are assuming worst case.

maximum inventory on site... 75 product cylinders & 5000 tail cylinders:

```
     product -  5,000 lbs UF6 -----  3,500 lbs U  (3.5% U-235)
     tail    - 27,000 lbs UF6 ----- 18,800 lbs U  (0.3% U-235)
     feed    - 27,000 lbs UF6 ----- 18,800 lbs U  (0.7% U-235)
```

```
where 6.022E23 atoms/238 grams U-238
     453 grams/lb
     1.146E24 atoms/lb U-238 if 100% abundant
     1.161E24 atoms/lb U-235 if 100% abundant

     per product cask per pound

     1.146E24 (0.965) = 1.105E24 atoms U-238
     1.161E24 (0.035) = 4.064E22 atoms U-235

          per cask:  3.867E27 atoms U-238
                     1.422E26 atoms U-235

     per tail cask:  2.148E28 atoms U-238
                     6.548E25 atoms U-235

     per feed cask:  2.139E28 atoms U-238
                     1.528E26 atoms U-235

activity (A) calculations:
     A = (ln2/T)N   where T = half-life, N = number atoms

     per product cask:
          A = (ln2/1.410E17 sec) 3.867E27 = 1.900E10 dps U-238
          A = (ln2/2.221E16 sec) 1.422E26 = 4.438E09  ps U-235
          A(total) = 2.344E10 dps = 0.633 Ci

     per tail cask:
          A = 1.056E11 dps U-238
          A = 2.044E09 dps U-235
          A(total) = 1.076E11 dps = 2.91 Ci

     per feed cask:
          A = 1.052E11 dps U-238
          A = 4.769E09 dps U-235
          A(total) = 1.10E11 dps = 2.97 Ci
```

TABLE 4.2-4

SUMMARY OF COMMITTED EFFECTIVE DOSE EQUIVALENTS

PATHWAY	COMMITTED EFFECTIVE DOSE EQUIVALENT (EDE) IN REM DUE TO ROUTINE FACILITY OPERATIONS			
	Organ	Class	EDE (a)	EDE (b)
LIQUID	red marrow	soluble	3.9E-5	3.9E-11
	bone surfaces	soluble	1.4E-4	1.4E-10
	kidneys	soluble	1.2E-4	1.2E-10
	red marrow	insoluble	1.6E-6	1.6E-12
	bone surfaces	insoluble	5.8E-6	5.8E-12
	ULI wall	insoluble	4.2E-6	4.2E-12
	LLI wall	insoluble	1.3E-5	1.3E-11
	kidneys	insoluble	4.8E-6	4.8E-12
	sum insoluble pathway		3.0E-4	3.0E-10
	sum soluble pathway		2.9E-5	2.9E-11
	sum liquid pathway		3.3E-4	3.3E-10
	Organ	Class	EDE (c)	
GASEOUS	red marrow	class D	7.0E-12	
	lungs	class D	3.0E-12	
	bone surfaces	class D	2.6E-11	
	kidneys	class D	2.1E-11	
	lungs	class W	1.5E-10	
	lungs	class Y	2.8E-9	
	sum gaseous pathway		3.0E-9	
TOTAL	both pathways		3.3E-9	

NOTES:

(a) EDE calculated using highly unlikely scenario of ingestion of one liter of Bluegill Pond Water to demonstrate insignificant radiological impact of plant operation.

(b) EDE calculated using dilution of Bluegill Pond water with Lake Claiborne. Dilution factor by Lake Claiborne is likely to be higher than used here, resulting in even lower EDE.

(c) EDE calculated using estimated releases of uranium over the operating year. Value can fluctuate based upon facility operation and dispersion. No deposition is factored into the calculation.

Table 4.2-5

Chemicals That May Be Processed Through the CEC Facility Liquid Effluent System

WATER TREATMENT CHEMICALS

- Chlorine
- Sodium Chloride
- Sodium Hydroxide

DECONTAMINATION SYSTEM CHEMICALS

- Citric Acid
- Potassium Hydroxide
- Hydrochloric Acid

OIL

- Hydrocarbon Oil

SOLVENTS

- Freon TF

DETERGENTS

LAB CHEMICALS

- Sodium Carbonate
- Sulfuric Acid
- Nitric Acid

COOLING WATER CHEMICALS

- Biocides

Table 4.2-6

Mean Seasonal and Annual Morning and Afternoon Mixing Heights and Average Windspeeds Through the Mixing Layer in Shreveport, Louisiana

	Winter		Spring		Summer		Autumn		Annual	
	H(m)[a]	U(m/sec.)[b]	H(m)[a]	U(m/sec.)[b]	H(m)[a]	U(m/sec.)[b]	H(m)[a]	U(m/sec.)[b]	H(m)[a]	U(m/sec.)[b]
Morning	508	6.3	566	6.7	482	4.8	400	4.8	497	5.7
Afternoon	1,088	6.7	1,484	7.1	1,820	4.8	1,414	5.4	1,452	6.0

[a]H = Mixing Heights
[b]U = Mixing Layer

(Reference 10)

Table 4.2-7

Episodes of High Meteorological Potential for Pollution Lasting at Least 2 Days Over a 5-Year Period in Shreveport

	Wind Speed (m/s)		
Mixing Height (m)	≤2.0	≤ 4.0	≤ 6.0
≤ 500	0/0	0/0	0/0
≤ 1000	0/0	4/9[W]	16/36[W]
≤ 1500	0/0	13/32[A]	52/144[A]
≤ 2000	0/0	34/84[A]	108/328[A]

Numerator equals total number of episodes; demoninator equals total number of episode-days.
[A]Autumn
[W]Winter

(Reference 10)

Table 4.2-8

Episodes of High Meteorological Potential for Air Pollution Lasting at Least 5 Days Over a 5-Year Period in Shreveport

Mixing Height (m)	Wind Speed (m/s) ≤2.0	≤ 4.0	≤ 6.0
≤ 500	0/0	0/0	0/0
≤ 1000	0/0	0/0	0/0
≤ 1500	0/0	0/0	3/16[W]
≤ 2000	0/0	0/0	12/71[A]

Numerator equals total number of episodes; denominator equals total number of episode-days.
[A]Autumn
[W]Winter

(Reference 10)

Table 4.2-9

Rank of Reciprocals of Mixing Heights and Wind Speed Through the Mixing Layer

Mixing Height (m)	Wind Speed (m/s) ≤2.0	≤ 4.0	≤ 6.0
500	1	2	3
1000	2	4	5
1500	3	5	7
2000	4	6	8

(Reference 10).

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4.3 RESOURCES COMMITTED

Site preparation, construction and operation of the enrichment facility commit both onsite and offsite resources, some of which are irreversibly committed and irretrievably lost.

4.3.1 ONSITE RESOURCES

The land area committed during site preparation and construction of the facility and transmission lines is a resource. Of the 442 acre LES property, approximately 94 percent is in upland forest, and 6 percent is man-made ponds. Only a portion of the site area, approximately 70 acres, is used for permanent (for projected plant life of 30 years) facilities. The balance of the LES property (372 acres) is recoverable as wildlife habitat upon restoration.

Of the developed 70 acres, approximately 50 acres are recently (within the last year) harvested upland mixed pine/hardwood forest, 14 acres are upland pine forest, and 6 acres are upland mixed pine/hardwood forest harvested 5 to 10 years ago.

Total land use requirements are detailed in Table 4.3-1. Prior to LES purchase of the site property, the former landowner negotiated with local timber dealers to remove marketable trees from the property with the exception of certain buffer areas that were left at the request and expense of LES. The buffer areas along with timber harvest areas are shown in Figure 4.3-1. The land owner retained the right to remove trees on approximately 90 percent of the land purchased by LES.

Operation of the enrichment facility will not further reduce wildlife habitat that was altered or destroyed by site preparation and construction of the facility.

There will be no additional impacts to the onsite aquatic resources by plant operation since the thermal, chemical, and turbid discharges are carefully monitored and controlled. Groundwater will be withdrawn from the Sparta Aquifer for facility operations as discussed in Section 2.5.2.4. The quantity of water used (approximately 5-7 gpm average) will be minimal as compared to the size of the aquifer. Other nearby groundwater users will not be affected by operation of the LES well.

Implementation of proper erosion control measures will minimize the effect of sediment deposit in the two on site ponds and the small creeks that drain off site.

4.3.2 OFF SITE RESOURCES

In addition to some on site resources that are irretrievably lost during construction, and operation, there will also be some offsite resources irretrievably lost. During construction, the heavy equipment on site will consume diesel fuel, processed oxygen, processed acetylene, and electricity.

Major materials required during plant construction include concrete aggregate and cement, reinforcing steel, lumber, piping materials, and electric wire and cable.

Concrete and steel constitute the bulk of construction materials; however, there are numerous other minor resources incorporated into the physical plant. Some materials, such as copper wire and cable, are valuable enough to be recycled, whereas the value of others does not encourage recycling.

Operation of the LES enrichment facility involves the enrichment of uranium hexafluoride with U-235 producing the U-235 enriched product and the partially depleted tails. The enriched product will be irreversibly consumed as nuclear reactor fuel, representing a fraction of the current reserves and potential resources of the United States. The amount of U-235 that will be processed as a consumable product by the LES facility is approximately 45,000 pounds per year. The tails will be stored on site as a resource for possible future enrichment operations.

Other resources committed during operation of the facility include water and electricity. The average ground water use during operation will be 5-7 gpm, all of which will effectively be discharged after treatment to nearby surface waters.

Electricity use at the facility is expected to be 18 MVA during normal operation. The amount of elect ical energy required to produce one SWU is 50 kWh which is approximately 1/50th of the energy required for the gas diffusion process which is currently the only other enrichment process applied on an industrial scale in the U.S.

Irretrievable and irreversible commitments of resources include those resources consumed during plant operation and those that are not expected to revert to a natural state if the structures are removed at the end of the station life.

Onsite decommissioning entails the removal of the stored tails, the processing and disposal of inplant water inventories, and the resultant processing and disposal of waste. It involves the salvage and sale of usable non-radioactive equipment and material. Materials and equipment contaminated or activated during station operation will be removed and transported to a low level waste storage facility. The buildings and facilities will be left intact and the property returned to a condition of unrestricted use as detailed in Section 4.4.

ITEM	TOTAL AREA	PASTURE	AGRICULTURE	FOREST[1]	OTHER[2]
CONTROLLED AREA	70	0	0	69	1
BALANCE OF SITE	372	0	0	352	20
	442	0	0	421	21

ALL LAND USE IN ACRES.

[1] FOREST LAND – INDICATES PRESENT USE OF LAND WITHOUT REGARD TO AGE OR CONDITION OF TREES.

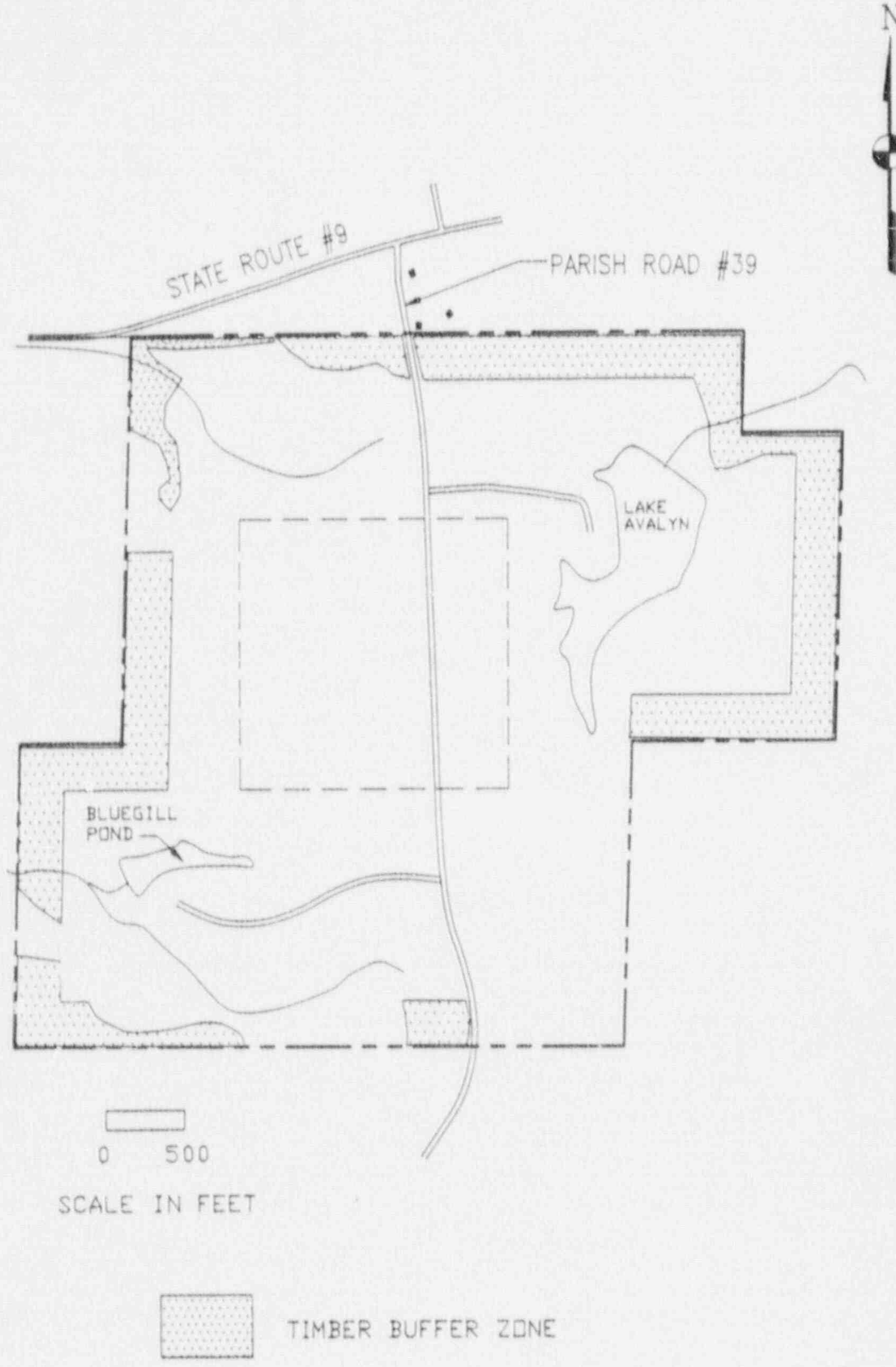
[2] OTHER – EX.: ROADS, PONDS, ETC.

CLAIBORNE ENRICHMENT CENTER

CEC

Land Use Requirements

Table 4.3-1



LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

CEC Site
Timber Buffer Zone

Figure 4.3-1

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4.4 DECOMMISSIONING AND DISMANTLING

At the end of useful plant life, the LES Claiborne Enrichment Center (CEC) will be decommissioned such that the site and facilities may be released for unrestricted use. Enrichment equipment will be removed; only building shells and the site infrastructure will remain. All remaining facilities will be decontaminated where needed to acceptable levels for unrestricted use. Confidential and Secret Restricted Data material, components, and documents will be destroyed/disposed of in accordance with the LES CEC Security Plan for the Protection of Classified Matter and Information. Depleted UF6 (tails), if not already sold or disposed of prior to decommissioning, will be sold, or will be converted to a stable, non-volatile uranium compound and disposed of in accordance with regulatory requirements. Radioactive wastes will be disposed of in licensed low-level waste disposal sites. Hazardous wastes will be treated or disposed of in licensed hazardous waste facilities. Neither tails conversion (if done), nor disposal of radioactive or hazardous material will occur at the plant site, but at licensed facilities located elsewhere.

Following decommissioning, no part of the facilities or site will remain restricted to any specific type of use.

Activities required for decommissioning have been identified, and decommissioning costs have been estimated. Activities and costs are based on actual operating experience. Urenco has a fully operational dismantling and decontamination facility at its Almelo plant; data and experience from this operating facility has allowed a very realistic estimation of decommissioning requirements. Using the cost data as a basis, financial arrangements are made to cover all costs required for returning the site to unrestricted use. Updates on cost and funding will be provided periodically. A more detailed LES CEC plan for completion of decommissioning will be submitted in accordance with 10 CFR Part 70.38 at or about the time of license termination.

The remaining subsections describe decommissioning plans and policies, steps to be taken at the end of plant life, the results of decommissioning, and the overall decommissioning costs and funding. The information here was developed in connection with the decommissioning cost estimate and is provided for information. Specific elements of the planning may change with the submittal of the decommissioning plan required at the time of license termination.

4.4.1 DECOMMISSIONING PLANS AND POLICIES

The plan for decommissioning is to promptly decontaminate or remove all materials from the site which prevent release of the facility for unrestricted use. This approach, referred to in the industry as DECON, avoids long-term storage and monitoring of wastes on site. For this reason it is the preferred alternative for decommissioning. (The other industry methods, SAFSTOR and ENTOMB, require storage and monitoring of wastes, primarily due to highly radioactive materials left on site. The type and amount of wastes produced at the CEC do not warrant delays in waste removal.) This section provides details of implementing the DECON approach.

Decommissioning planning begins with incorporating special design features into the plant. These features will simplify eventual dismantling and decontamination. The plans are implemented using proper management and health and safety programs. Decommissioning policies also address radioactive and hazardous waste management, physical security, and material control and accountability. Each of these planning and policy areas is discussed in the remainder of this section.

4.4.1.1 <u>Decommissioning Design Features</u>

Specific features are incorporated into the facility design which accommodate decontamination and decommissioning required to implement DECON. The major features are described below.

4.4.1.1.1 Radioactive Contamination Control

The following features minimize the spread of radioactive contamination during operation and therefore simplify eventual plant decommissioning. (As a result, worker exposure to radiation, and radioactive waste volumes are minimized as well.)

a. Certain activities during normal operation are expected to result in surface and airborne radioactive contamination. Specially designed rooms are provided for these activities to preclude contamination spread. These rooms are isolated from other areas and are provided with ventilation and filtration. The Pump Disassembly Rooms and the Contaminated Workroom meet these specific design requirements. (See Figure 3.3-9, Separations Building Floor Plan, for room locations.)

b. All areas of the plant are sectioned off into clean areas and potentially contaminated areas. The potentially contaminated areas are called Radiation Control Areas (RCAs) and have access control requirements. Areas actually contaminated are called Radiation Control Zones (RCZs). These RCZs have additional access controls, and a number of requirements are imposed on work procedures for contamination control. The boundaries of permanent RCAs and RCZs in the Separations Building are shown in Figure 4.4-1, Radiation Control Zones. All procedures for these areas fall under the health physics program, and serve to minimize the spread of contamination and simplify eventual decommissioning.

c. Non-radioactive process equipment and systems are minimized in locations subject to contamination. This limits the size of the RCZs, and limits the activities occurring inside these areas.

d. Local air filtration is provided for areas with potential airborne contamination to preclude its spread. Portable ventilation units and fume hoods filter contaminated air in these areas.

e. Curbing, provided around tanks and components which contain radioactive wastes, serves to control contamination spread in case of a spill.

4.4.1.1.2 Worker Exposure and Waste Volume Control

The following features help minimize worker exposure to radiation and minimize radioactive waste volumes during decontamination activities. (As a result, the spread of contamination is minimized as well).

a. During construction, a washable epoxy coating is applied to floors and walls that are expected to be radioactively contaminated during operation. The coating will serve to lower waste volume during decontamination and simplify the decontamination process. The coating is applied to all floors and walls in the Radiation Control Areas. (See Figure 4.4-1 for the Separations Building RCA boundaries).

b. Sealed nonporous pipe insulation is used in areas likely to be contaminated. This will reduce waste volume during decommissioning.

c. Ample access is provided for efficient equipment dismantling and removal of equipment that may be contaminated. This minimizes the time of worker exposure.

d. Tanks are provided with accesses for entry and decontamination. Design provisions are also made to allow complete draining of the wastes contained in the tanks.

e. Connections in the process systems are provided for thorough purging at plant shutdown. This will remove a significant portion of radioactive contamination prior to disassembly.

f. Design drawings, produced for all areas of the plant, will simplify the planning and implementing of decontamination procedures. This in turn will shorten the durations that workers are exposed to radiation.

g. Worker access to contaminated areas is controlled to assure that workers wear proper protective equipment and limit their time in the areas.

4.4.1.2 Administrative Policies

4.4.1.2.1 Management/Organization

Management of the decommissioning program will assure that proper training and procedures are provided to assure worker health and safety. The programs will focus heavily on minimizing waste volumes and worker exposure to hazardous or radioactive materials. Qualified contractors assisting with decommissioning will likewise be subject to CEC training requirements and procedural controls.

4.4.1.2.2 Health and Safety

As with normal operation, the policy during decommissioning shall be to keep individual and collective occupational radiation exposure as low as reasonably achievable (ALARA). A health physics program will identify and control sources of radiation, establish worker protection requirements, and direct the use of survey and monitoring instruments.

4.4.1.2.3 Waste Management

Radioactive and hazardous wastes produced during decommissioning will be collected, handled, and disposed of in accordance with regulations applicable to the CEC at the time of decommissioning. Generally, procedures will be similar to those required for wastes produced during normal operation. These wastes will ultimately be disposed of in licensed radioactive or hazardous waste disposal facilities located elsewhere. Non-hazardous and non-radioactive wastes will be disposed of in a manner consistent with good industrial practice, and in accordance with applicable regulations.

4.4.1.2.4 Security / Material Control

Requirements for physical security and for material control and accountability will be maintained as required during decommissioning in a manner similar to the programs in force during operation. The LES CEC plan for completion of decommissioning, submitted near the end of plant life, will provide a description of any necessary revisions to these programs.

4.4.1.2.5 Record Keeping

Records important for safe and effective decommissioning of the facility shall be kept in LES files. Information maintained in these records includes:

a. Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site,

b. As-built drawings and modifications of structures and equipment in restricted areas where radioactive materials are used and/or stored, including locations which possibly could be inaccessible, and

c. Records of the cost estimate performed for the decommissioning funding plan, and records of the funding method used for assuring funds.

4.4.2 DECOMMISSIONING STEPS

Implementation of the DECON alternative for decommissioning may begin immediately following final shutdown, because only low radiation levels exist at this facility. Overall, the DECON alternative is estimated to require approximately five years from plant shutdown to completion of the final radiation survey. The order of activities to support decommissioning will generally be: installation of decontamination facilities, process system purging, equipment dismantling and removal, decontamination, destruction of Confidential and Secret Restricted Data material, sale of salvage, disposal of wastes, and completion of a final radiation survey. The next paragraphs provide an overview and explanation of each of the steps in more detail.

4.4.2.1 Overview

Decommissioning, using the DECON approach, requires residual radioactivity to be reduced below acceptable levels so the facilities may be released for unrestricted use. Current Nuclear Material Safety and Safeguards guidelines for release serve as the basis for decontamination costs estimated herein. Portions of the facility which do not exceed contamination limits may remain as is. The intent of decommissioning the CEC is to remove all enrichment-related equipment from the buildings such that only the building shells and site infrastructure remain. The removed equipment includes: all piping and components from systems providing UF6 containment, systems in direct support of enrichment (such as refrigerant and chilled water), radioactive and hazardous waste handling systems, contaminated HVAC filtration systems, etc. The remaining site infrastructure will include services such as electrical power supply, treated water, fire protection, HVAC, plant cooling water, communications, and sewage treatment.

Decontamination of plant components and structures will require installation of two new facilities dedicated for that purpose. Existing plant buildings are assumed to house the facilities. One facility will be especially designed to accommodate repetitive cleaning of thousands of centrifuges, and the other will serve as a general purpose facility used primarily for larger components. The two new facilities will be the primary location for decontamination activities. The small decontamination area in the Separations Building TSA, used during normal operation, may also handle small items at decommissioning.

Decontaminated components may be reused or sold as scrap. All equipment that is to be reused or sold as scrap will be decontaminated to a level at which further use is unrestricted. Table 4.4-1, Items for Decontamination at Decommissioning, lists all major items on the site expected to require decontamination. Materials which cannot be decontaminated will be disposed of in a radioactive waste disposal facility.

Any UF6 tails still on site will be removed from the site at decommissioning. Depending on technological developments occurring prior to plant shutdown, the tails may have become marketable for further enrichment or other processes. However, funding provisions are made to dispose of the tails should that become necessary.

Contaminated portions of the buildings will be decontaminated as required. Structural contamination should be limited to the areas indicated on Figure 4.4-1 as being inside the Radiation Control Zones of the plant. The remainder of the site, including the Hold-Up Basin and all land area, is not expected to require decontamination. (Good housekeeping practices during normal operation will maintain the other areas clean.) When decontamination is complete all areas and facilities on the site will be surveyed to verify further decontamination is not required. Decontamination activities will continue until the entire site is demonstrated to be suitable for unrestricted use.

4.4.2.2 Decontamination Facility Construction

New facilities for decontamination can be installed in existing plant buildings to avoid unnecessary expense. Estimated time for installation is approximately one year following plant shutdown. Details of the facilities are provided below in Section 4.4.2.5 with the discussion of the decontamination process.

4.4.2.3 System Cleaning

At the end of the useful life of the facility, the enrichment process is shutdown and UF6 is removed to the fullest extent possible by normal process operation. This is followed by evacuation and purging with nitrogen. This shutdown and purging portion of the decommissioning process is estimated to take approximately three months.

4.4.2.4 Dismantling

Dismantling is simply a matter of cutting out, disconnecting, etc., all components requiring removal. The operations themselves are simple but very labor intensive. They generally require the use of protective clothing. The work process will be optimized, considering the following:

a. Minimizing contamination spread and the need for protective clothing,

b. Balancing the number of cutting and removal operations with the resultant decontamination and disposal requirements,

c. Optimizing the rate of dismantling with the rate of decontamination facility throughput,

d. Providing storage and laydown space required, as impacted by retrievability, criticality safety, security, etc., and

e. Balancing the cost of decontamination and salvage with the cost of disposal.

Details of the complex optimization process will necessarily be decided near the end of plant life, taking into account specific contamination levels, market conditions, and available waste disposal sites. To avoid laydown space and contamination problems, dismantling should be allowed to proceed generally no faster than the downstream decontamination process. The time frame to accomplish both dismantling and decontamination is estimated to be approximately three years.

4.4.2.5 Decontamination

The facilities, procedures, and expected results of decontamination are described in the paragraphs below. Table 4.4-1 lists major components and structures expected to need decontamination on site. Complete decontamination of the plant is estimated to require three years to complete.

Since reprocessed uranium will not be used as feed in the CEC, no consideration of U232, transuranic alpha-emitters and fission product residues is necessary for the decontamination process.

Only contamination from U238, U235, U234, and their daughter products will require handling by decontamination processes. The primary contaminant throughout the plant will be in the form of UO2F2, with much smaller amounts of UF4 and other compounds.

4.4.2.5.1 Facilities

Two decontamination facilities will be required to accommodate decommissioning. A specialized facility is needed for optimal handling of the thousands of centrifuges to be decontaminated, along with the UF6 pumps and valves. Additionally, a general purpose facility is needed for handling the remainder of the various plant components. These facilities are assumed to be installed in existing plant buildings (such as the Centrifuge Assembly Building).

The specialized facility will have four functional areas: a disassembly area, a buffer stock area, a decontamination area, and a scrap storage area for cleaned stock. The general purpose facility may share the specialized facility decontamination area. However, due to handling needs for various sizes and shapes of other plant components, the disassembly area, buffer stock areas and scrap storage areas may not be shared.

Equipment in the decontamination facilities will include:

a. Transport and manipulation equipment,

b. Dismantling tables, for centrifuge externals,

c. Sawing machines,

d. Dismantling boxes and tanks, for centrifuge internals,

e. Degreasers,

f. Citric acid and demineralized water baths,

g. Contamination monitors,

h. Wet blast cabinet,

i. Crusher, for centrifuge rotors,

j. Smelting and/or shredding equipment, and

k. Scrubbing facility.

The decontamination facilities provided in the Technical Services Area for normal operational needs would also be available for cleaning small items during decommissioning.

4.4.2.5.2 Procedure

Procedures for decontamination will be developed and approved by plant management to minimize worker exposure and waste volumes, and to assure that work is carried out in a safe manner. The experience of decommissioning European gas centrifuge enrichment facilities will be incorporated extensively into the procedures.

At the end of plant life, some of the equipment, most of the buildings, and all of the outdoor areas should already be acceptable for release for unrestricted use. If they are accidentally contaminated during normal operation they would be cleaned up when the contamination is discovered. This limits the scope of necessary decontamination at the time of decommissioning.

Contaminated plant components will be cut up or dismantled and processed through the decontamination facilities. Contamination of site structures will be limited to specific Radiation Control Zones in the Separations Building, and will be maintained at low levels throughout plant operation by regular cleaning. The only permanent RCZs are the Contaminated Equipment Workshop, the Decontamination Workshop, the Contaminated Workroom, the Pump Disassembly Rooms, and a portion of the Laundry Room. Due to applied coatings and good housekeeping practices, final decontamination of these areas is assumed not to require significant removal of surface concrete or other structural material.

The centrifuges will be processed through the specialized facility with the following operations performed:

a. Removal of external fittings,

b. Removal of bottom flange, motor and bearings, and collection of contaminated oil,

c. Removal of top flange, withdrawal and disassembly of internals,

d. Degreasing of items as required,

e. Decontamination of all recoverable items for smelting, and

f. Destruction of other classified portions by shredding, crushing, smelting, etc.

4.4.2.5.3 Results

As Urenco plant experience in Europe has demonstrated, conventional decontamination techniques are entirely effective for all plant items. All recoverable items will be decontaminated and suitable for reuse except for a very small amount of intractably contaminated material. Material requiring disposal will primarily be centrifuge rotor fragments, trash, and residue from the effluent treatment systems. No problems are anticipated which will prevent the site from being released for unrestricted use.

4.4.2.6 Sale/Salvage

Items to be removed from the facilities can be categorized as potentially re-usable equipment, recoverable scrap, and wastes. However, based on a 30-year facility operating life, operating equipment is not assumed to have reuse value. Wastes will also have no salvage value.

With respect to scrap, a significant amount of aluminum will be recovered, along with smaller amounts of steel, copper, and other metals. For security and convenience these materials will likely be smelted into standard ingots, then sold at market price. Estimated recovery values are provided below in Section 4.4.4.

4.4.2.7 Disposal

All wastes produced during decommissioning will be collected, handled, and disposed of in a manner similar to that described for those wastes produced during normal operation. Wastes will consist of normal industrial trash, non-hazardous chemicals and fluids, small amounts of hazardous materials, and radioactive wastes. The radioactive waste will primarily be crushed centrifuge rotors, trash, and citric cake. Citric cake consists of uranium and metallic compounds precipitated from citric acid decontamination solutions. It is estimated that approximately 100 cubic meters of radioactive waste will be generated over the five-year decommissioning operation. (This waste is subject to further volume reduction processes prior to disposal.)

Radioactive wastes will ultimately be disposed of in licensed low-level radioactive waste disposal facilities. Hazardous wastes will be disposed of in hazardous waste disposal facilities. Non-hazardous and non-radioactive wastes will be disposed of in a manner consistent with good industrial practice and in accordance with all applicable regulations. A complete estimate of the wastes and effluent to be produced during decommissioning will be provided in the LES CEC plan for completion of decommissioning, to be submitted near the end of license termination.

Any UF_6 tails still on site will be removed from the site at decommissioning. Depending on technological developments prior to plant shutdown, the tails may have become marketable for further enrichment or other processes. Since this is not assured, funding arrangements have been made to dispose of the tails. Tails disposal would be accomplished in accordance with all applicable regulations. The UF6 conversion and disposal options will vary. Conversion and disposal would be accomplished at non-LES facilities elsewhere. The UF6 would be converted to a stable, non-volatile uranium compound prior to disposal.

Confidential and Secret Restricted Data components and documents on site shall be disposed of in accordance with the requirements of 10 CFR Part 95. Such classified portions of the centrifuges will be destroyed, piping will likely be smelted, documents will be destroyed, and other items will handled in an appropriate manner. Details will be provided in the LES CEC Security Plan for the Protection of Classified Matter and Information, submitted separately in accordance with 10 CFR Part 95.

4.4.2.8 Final Radiation Survey

A final radiation survey must be performed to verify proper decontamination to allow the site to be released for unrestricted use. The evaluation of the final radiation survey is based in part on an initial radiation survey performed prior to operation. The initial survey determines the natural background radiation of the area; therefore it provides a datum for measurements which determine any increase in levels of radioactivity.

The final survey will systematically measure radioactivity over the entire site. The intensity of the survey will vary depending on the location (i.e. the buildings, the immediate area around the buildings, the controlled fenced area, and the remainder of the site). The survey procedures and results will be documented in a report. The report will include, among other things, a map of the survey site, measurement results, and the site's relationship to the surrounding area. The results will be analyzed and shown to be below allowable residual radioactivity limits, or further decontamination will be performed.

4.4.3 DECOMMISSIONING RESULTS

The results of decommissioning are presented below, including the impact on the environment, the final condition of the land and facilities, and the long-term use of the land.

4.4.3.1 Environmental Consequences

The impact of decommissioning on the environment can best be understood by comparing decommissioning activities with operating activities, and by noting the condition of the site and surrounding land when decommissioning is complete. Decommissioning differs from operation in areas of resource consumption, type and amount of effluents and wastes, and duration of activities.

The consumption of electric power and water changes significantly once decommissioning begins. Electric power usage drops dramatically due to plant shutdown, and water usage will increase to accommodate decontamination processes. The increase in water usage will occur primarily during years two through four of the five-year decommissioning program, when decontamination is performed. (See Table 4.4-2, Estimated Decommissioning Costs and Duration, for an estimated schedule for each major decommissioning step. The first year is taken with shutdown, facility installation, and dismantling and the final year is spent performing the final radiation survey).

Plant thermal, liquid, and gaseous effluents also change significantly during decommissioning. The thermal effluents will become insignificant once the plant is shut down. On the other hand, the portion of liquid effluent resulting from decontamination processes will show a marked increase. Primarily this effluent will result from use of citric acid baths for decontamination. (Once citric acid bath solution is spent, the uranium is removed, heavy metals are removed as required, and the pH of the remaining solution is adjusted. The treated solution, once it meets release limits, is then discharged to the environment. The quantity of this solution will increase during decommissioning).

Gaseous effluent volume drops slightly during decommissioning since the process off-gas inputs to the stack are shut down. Since no UF_6 is being processed during decommissioning, there are no longer trace amounts of UF_6 or HF in the effluent stream. The only significant amount of gaseous effluent during decommissioning is clean air from HVAC systems.

Waste production during decommissioning will change as well. The most significant waste categories during decommissioning will include crushed centrifuge rotors, normal trash, and uranium-containing "citric cake" from the citric acid baths. Annual radioactive solid waste volumes produced during the decontamination phase of decommissioning (years two through four) have been estimated. The volume of total radioactive waste these three years is found to be roughly equal to radioactive solid waste volumes produced during normal operation. Radioactive wastes in the first and last year of decommissioning should be much lower than during normal operation.

At the close of decommissioning the site and surrounding land is returned to unrestricted access. During the course of operation the land area will have returned to its natural state. This will be an improvement for plant and animal life since prior to operation the land had been regularly logged. Wildlife and natural vegetation should be abundant. Plant decommissioning will leave behind an excellent industrial facility surrounded by several hundred acres of land in its natural state.

4.4.3.2 Post-Decommissioning Site and Facilities

The LES property, which is approximately 442 acres, is divided into two areas. The CEC facility is located on a 70-acre section, and the remainder of the acreage is restricted for public access with no industrial use.

Following decommissioning, the 70-acre area will retain its infrastructure and will serve as an ideal facility for another industry. The site buildings and roads will be retained for reuse. A number of systems will remain as well to support the facility. These systems include treated water, fire protection, HVAC, plant cooling water, sewage treatment, communications, and electrical power supply. However, a majority of the systems and equipment in the CEC facilities is uniquely related to the enrichment process, and will be removed. Removed items will include the centrifuges, all UF6 process piping and equipment, certain cooling water systems, refrigeration systems, radioactive and hazardous waste handling equipment and piping, contaminated HVAC filtration systems, UF6 cylinder handling equipment, and other miscellaneous systems and components. All hazardous and radioactive materials will be removed from the site. The lake and pond on the site will be clean and will support populations of fish and other wildlife in the area. Overall, the decommissioned facility will be in excellent condition and will be an asset to the area.

The land surrounding the 70-acre CEC site will have restricted public access during normal operation, and so will return to its natural state. As discussed in the previous section, the land will have improved over the course of plant operation such that wildlife should be abundant and the natural vegetation should be thriving.

4.4.3.3 Long Term Land Use

Following decommissioning, no restrictions will exist on the long term use of the land. Operation of the CEC will not cause any land to be irretrievably committed for any specific use. Residual radioactive contamination will be within the safe limits specified in applicable regulations for the protection of the health and safety of the public and the environment. Specific plans for lease, sale, or other use of the land will be determined near the end of plant life.

4.4.4 DECOMMISSIONING COSTS AND FUNDING

This section provides an estimation of decommissioning costs, and explains the arrangements made to assure funding is available to cover these costs.

4.4.4.1 Decommissioning Costs

Table 4.4-2, Estimated Decommissioning Costs and Duration, provides a summary listing of the costs of the major decommissioning activities described above in Section 4.4.2. All costs are in 1990 dollars. As shown in the table, the estimated total cost is $20 million, not including the cost of tails disposal. Tails disposal costs are provided on an annual basis and are estimated to be $9.5 million/year (Reference 4.4-1, Section 6.0, 5th item). Costs and salvage values are anticipated to change between the time of license application and decommissioning. The cost estimate will be adjusted periodically consistent with the requirements of 10 CFR Part 70.25 (e) and the guidance in Regulatory Guide 1.159.

4.4.4.2 Funding Arrangements

The funds for decommissioning the facility will be provided in the form of a surety method, insurance, or other guarantee method as required by 10 CFR Part 40.36 (e) and 10 CFR Part 70.25 (f). The selected guarantee method is described in the decommissioning funding plan which is presented in the CEC License Application. As a part of this plan, methods are described for periodic adjustments in the cost estimate, and resulting necessary adjustments to the funding method.

REFERENCES FOR SECTION 4.4

1. LES CEC Depleted UF6 Disposition Study, September, 1990, prepared by Duke Engineering and Services, Inc.

Table 4.4-1 (Page 1 of 2)
Items for Decontamination at Decommissioning

Category	Description	Quantity
Pumps	Vent vacuum pumps	43
	Process vacuum pumps	198
	Waste disposal pumps	18
Centrifuges	Aluminum (tons)	5000
Piping	Aluminum, some steel (tons)	280
Gaseous effluent piping/ductwork	Diameter ≥ 14" (ft)	700
	Diameter 8 to 12" (ft)	500
	Diameter ≤ 6" (ft)	10,000
HVAC	TSA ductwork (length, ft)	400
	Filter housing (7'x7'x17')	3
Bldg surfaces	Floors and walls (ft^2)	10,000
Valves	Process valves	2500
Traps	Chemical traps	28
	Carbon traps	15
	Activated alumina traps	61
	Oil traps	49
	Sodium fluoride traps	42
Tanks	Liquid waste tanks	18
	Decontamination baths	6
Effluent pits	Plant unit and TSA pits	4

Table 4.4-1 (Page 2 of 2)
Items for Decontamination at Decommissioning

Category	Description	Quantity
Other equipment	Desublimers	13
	Cont. dump surge vessels	42
	UF6 sample rigs	6
	Clothes washers	2
	Clothes dryers	2
	Wet blasting cabinets	1
	Decon degreasing units	2
	Fomblin oil fume hood	1
	Fomblin oil centrifuge	1
Stillage assembly	48" stillage	26
	30" stillage	26
Final decontamination facility	Centrifuge transporter	2-3
	Centrifuge manipulator	2-3
	Centrifuge dismantling eq (table/saw/tank/box)	1
	Sawing machines	4
	Degreasers	2
	Decontamination tanks	6
	Wet blast cabinet	1
	Crusher	1
	Smelter	1

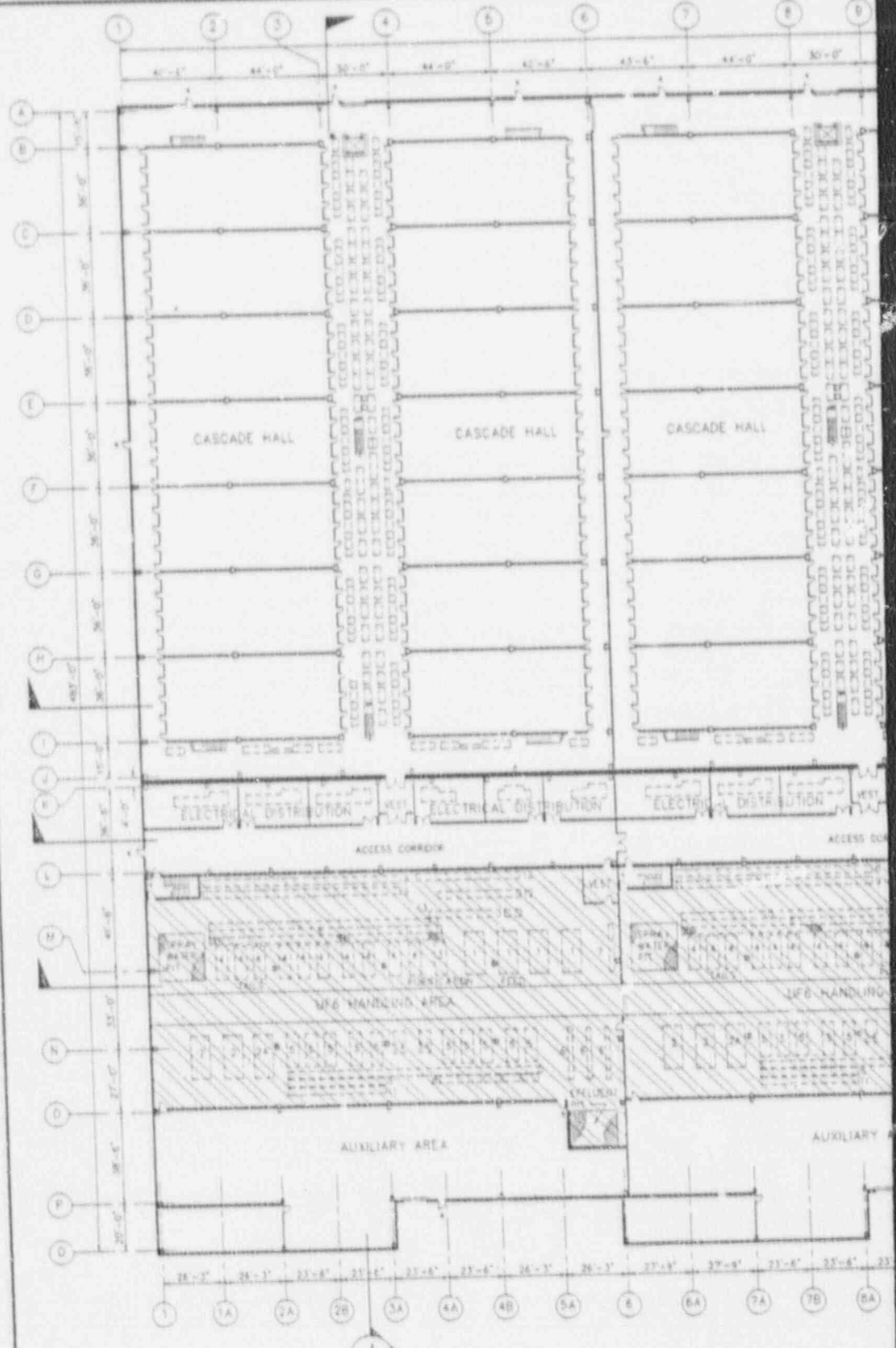
Table 4.4-2
Estimated Decommissioning Costs and Duration

Activity		Cost (Millions, 1990 $s)	Time (Yrs)
Decontamination Facility Installation	Capital	$ 5.6	< 1
	Labor	1.1	
System Cleaning		0.9	1/4
Dismantling		5.6	3
Decontamination		11.6	
Sale/Salvage		(6.5)	(a)
Waste Disposal		0.8	(a)
Tails Disposal		(b)	(a)
Final Radiation Survey		0.8	1
TOTALS		$ 20 + Tails (b)	5 yrs

For related information, reference also the decommissioning funding plan contained in the CEC License Application.

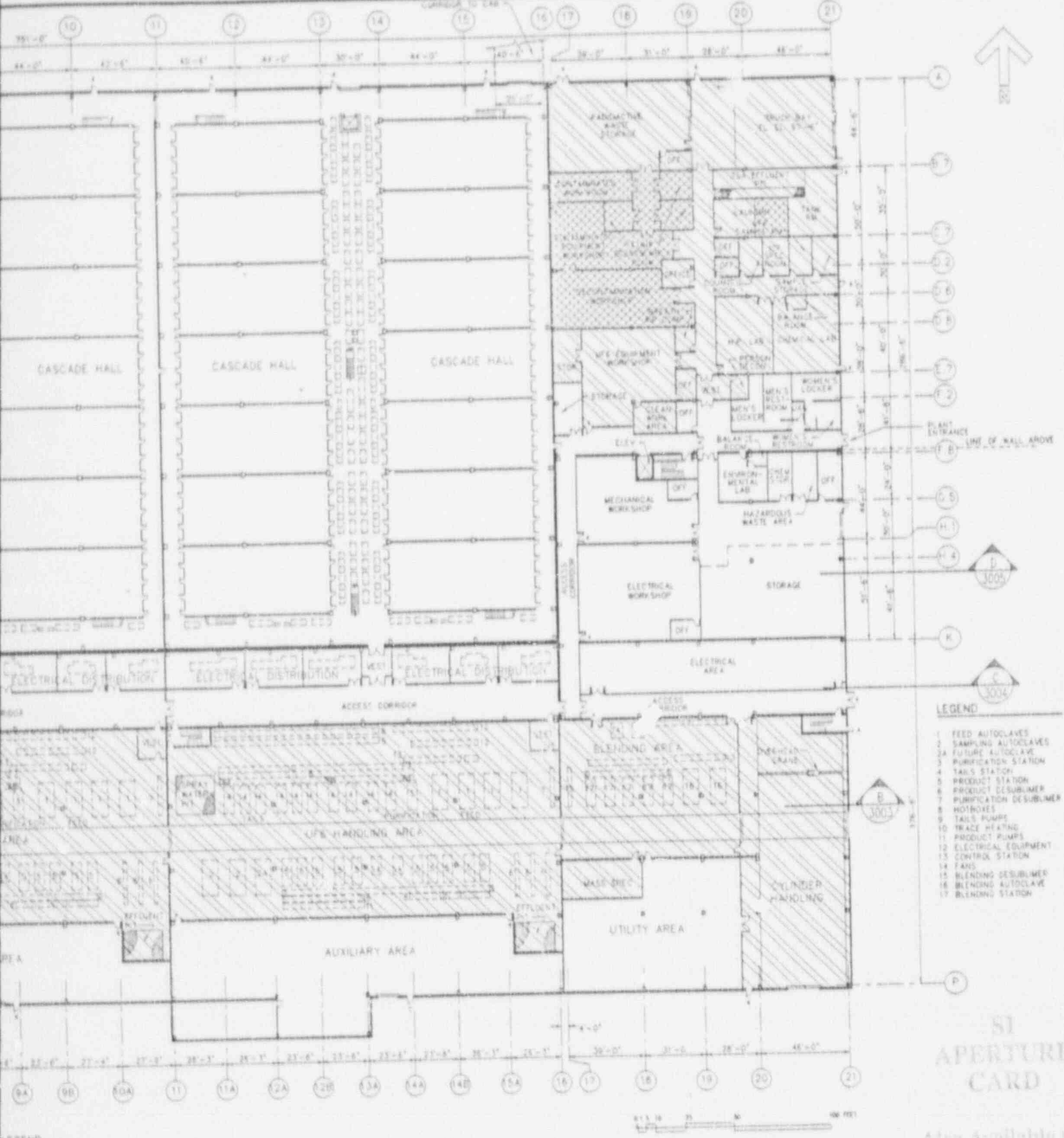
(a) To be performed along with dismantling and decontamination.

(b) Tails disposal costs are estimated to be $9.5 million per year of tails production.



NOTES

1. PORTABLE FIRE EXTINGUISHERS SHALL BE INSTALLED IN ACCORDANCE WITH N.F.P.A. 10
2. × × ALARMED EMERGENCY EXIT DOOR



LEGEND

RADIATION CONTROL AREA

RADIATION CONTROL ZONE

DWG. NO. 4-30-0-3000 REV.03 SHEET 1 OF 1

LOUISIANA ENERGY CLAIBORNE ENRICHMENT CENTER

RADIATION CONTROL ZONES

Figure 4.4-1

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4.5 RADIOACTIVE MATERIAL MOVEMENT

The transportation of radioactive materials may have environmental effects. In this section a description is provided of the uranium feed to be used, the quantities of radioactive materials transported to and from the site, and the radioactive wastes from the site.

4.5.1 URANIUM FEED

The uranium feed for the Claiborne Enrichment Center (CEC) is natural uranium in the form of uranium hexafluoride (UF6). No reprocessed uranium is used as feed material for the facility. The uranium hexafluoride (UF6) is transported to the facility in 48X or Y cylinders. These cylinders are designed, fabricated and shipped in accordance with American National Standard (ANSI) N14.1-1987, Uranium Hexafluoride - Packaging For Transport. Feed cylinders are transported to the site by modified flat bed truck, two per truck. Therefore, a maximum of 55,120 pounds (27,560 pounds per cylinder) is transported per truck. There are approximately 374 feed cylinders or 187 shipments of feed cylinders per year.

4.5.2 URANIUM PRODUCT

The product of the CEC is transported in 30B cylinders. These cylinders are designed, fabricated and shipped in accordance with American National Standard (ANSI) N14.1-1987, Uranium Hexafluoride - Packaging For Transport. Product cylinders are transported from the site to fuel fabrication facilities by modified flat bed truck, typically two per truck although up to 5 product cylinders could be transported on the same truck. Therefore, a maximum of 25,100 pounds (5,020 pounds per cylinder) of enriched uranium could be transported per shipment. There are approximately 380 product cylinders shipped per year.

4.5.3 URANIUM WASTES

Detailed descriptions of radioactive waste materials which will be shipped from the CEC facility for disposal are presented in Chapter 6 of the Safety Analysis Report. Table 4.5-1 presents a summary of these waste materials.

4.5.4 TRANSPORTATION

The feed and product materials of the facility will be transported by truck. Feed material is obtainable from UF6 conversion facilities near Gore, Oklahoma and Metropolis, Illinois. The product could be transported to fuel fabrication facilities near Hanford, Washington; Columbia, South Carolina; Wilmington, North Carolina; Windsor, Connecticut; Lynchburg, Virginia; or Hematite, Missouri. The designation of the supplier of UF6 and the product receiver is the responsibility of the customer. Table 4.5-2 lists the approximate highway distances from the CEC to the conversion facilities and fuel fabrication facilities.

Table 4.5-1

Categories and Quantities of CEC Radioactive Wastes Requiring OffSite Shipmert and Disposal

Liquid Waste	Weight (Lbs/Yr)	Volume (Gal/Yr)	Uranium (Lbs/Yr)
Solvents	___	25	11
Oil	___	25	Trace
Chemicals	___	750	110
Solid Waste			
Trash	16,000	___	22
Filters	1,850	___	1
Activated Carbon	1,500	___	120
Activated Alumina	350	___	4
Scrap Metal	290	___	Trace
Fomblin Oil Recovery Sludge	55	___	1
Decontamination Abrasive	600	___	6
Waste Processing Precipitate	1,800	___	57
Gaseous Wastes			
None			

Table 4.5-2
Distances to UF6 Feed and Product Locations

UF6 Feed Suppliers:

Location	Approximate Distance to Louisiana Energy Services CEC
Gore, OK	367 miles
Metropolis, IL	499 miles

UF6 Product Destinations:

Location	Approximate Distance to Louisiana Energy Services CEC
Hanford, WA	2,129 miles
Columbia, SC	827 miles
Wilmington, NC	1,027 miles
Windsor, CT	1,594 miles
Lynchburg, VA	1,112 miles
Hematite, MO	490 miles

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5.0 ENVIRONMENTAL EFFECTS OF ACCIDENTS

This chapter discusses the environmental effects of possible accidents that may occur at the plant or during the transportation of materials to or from the facility.

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5.1 URANIUM ENRICHMENT FACILITY ACCIDENTS

A stepwise approach has been used to determine the environmental effects of potential accidents. This approach presents the following data and subsequent evaluations:

a. Tabulate all chemicals and radiochemicals used in the operation;

b. Determine the physical state of the materials in Step 1;

c. Determine the in-process or in-storage inventory of each of the materials identified in Step 1;

d. Estimate the magnitude of the potential accidents and the consequences of these accidents;

e. Specify the properties of each material that are important to its dispersibility and effects;

f. Subject each of the materials of concern to the theoretical accident scenario to yield the most damaging effects; and

g. Using the derived information from the above steps, compare the predicted concentrations of the worst case accident scenario to published impact threshold criteria.

The term accident as it is used in this section encompasses a variety of events. These events include the following.

a. Events that result in a release of hazardous material in sufficient quantities to endanger the public are usually called accidents.

b. Events that result in a release of hazardous material in quantities that do not endanger the public but could endanger plant workers are usually called abnormal events.

c. Events that include equipment failures that do not result in a release of hazardous materials but could interrupt plant production are usually called process upsets.

5.1.1 INTRODUCTION

During design of the CEC facility, over 30 accident analyses were performed. These are discussed in Sections 2.3, 2.4, 4.5, 9.0, 9.1 and 9.2 of the Safety Analysis Report (SAR, Reference 1). Some of the accidents analyzed in the SAR are addressed from an ultraconservative, "worst case" perspective. This is done in order to insure that the CEC facility design incorporates engineered safety features which are adequate to protect the health and safety of the public.

Section 5.1 of the Environmental Report (ER) has a different purpose than the SAR. The objective of the ER is to provide an evaluation of the environmental effects associated with potential accidents, including a comparison of the worst case credible scenarios to published impact criteria. The focus of the ER is on expected consequences, rather than the expected frequency as in the SAR.

Potential accidents at the CEC facility may be of two basic types: UF6 accidents and other types of accidents. The most important class of accidents involve UF6. This is the principal chemical compound processed by the CEC in large quantities. Although UF6 is radioactive, the principal threat posed by it is chemical toxicity. The CEC design includes a large number and variety of safeguards which are designed to prevent or mitigate accidents involving UF6. LES has also developed additional engineered safety features in response to lessons learned from minor incidents at Urenco facilities in Europe. The CEC design includes all of these proven design features. The CEC includes sufficient number, variety and quality of engineered safety features such that the design prevents the occurrence of any UF6 accident which could endanger the health and safety of the public. The CEC also includes a large number of features which are designed to protect plant workers from UF6 accidents. Taken together, these design provisions have the effect of minimizing environmental impact from UF6 accidents. UF6 accidents are discussed in Section 5.1.2.

The second class of accidents involves other industrial chemicals on the site. These are not radioactive, but some of them can be a hazard if they are allowed to escape from the plant. There are several such chemicals that are of interest. Most are present onsite in small quantities. Each is handled pursuant to regulations and industrial codes; consequently, the design is considered to be safe in regard to these substances. These accidents are discussed in Section 5.1.3.

The CEC site location with respect to the state is shown in Figure 2.1-1 and the parish in Figure 2.1-2. The 442 acre CEC site is shown in Figure 2.1-3.

5.1.2 POTENTIAL EVENTS INVOLVING UF6 RELEASES

Potential events involving UF6 releases fall into two categories:

a. Events which are not expected to occur. In some cases the probability of these events is remote. In others cases the plant design and operating procedures include provisions which will prevent these events from occurring (i.e., the design renders them non-credible) or substantially reduce the likelihood of occurrence. All large scale UF6 release scenarios have been rendered non-credible by design provisions.

b. Events which appear to have some probability of occurrence during the life of the plant. UF6 releases, should they occur, are likely to be associated with this category of event. In no case could the releases from such events endanger the health and safety of the public.

The CEC is designed to have adequate "defense in depth" to assure public and worker safety. The events analyzed are primarily chemical in nature because chemical toxicity is a greater concern than radiation exposure when dealing with UF6. The specific details of these events are presented in Chapter 9 of the SAR (Reference 1).

5.1.2.1 Criticality

The maximum enrichment level at the CEC is 5.0 wt % U235. The CEC has been designed and will be constructed to ensure that a nuclear criticality cannot occur. Consequently, no direct radiation or release of fission products can occur. Criticality is discussed in detail in Section 4.5 of Reference 1. The following discussion explains why criticality accidents cannot occur.

Almost every plant component in which criticality is a potential threat is designed to be safe by geometry (i.e., safe by shape). Criticality cannot occur in components which are safe by shape.

Three types of plant components do not comply with the safe-by-shape criteria. These include:

a. Product desublimers

b. Product cylinders

c. Liquid effluent monitoring tanks

d. Decontamination tanks

e. Citric acid collection tanks

The plant design employs moderation control methods to prevent criticality in the product desublimers and product cylinders. Moderation control design features include the following.

a. Use of electrically heated air rather than steam to heat and vaporize UF6. This keeps UF6 out of contact with water.

b. Use of air, chilled by Freon R-11 refrigerant (not water), to desublime UF6 and cool cylinders in the product take-off stations. This keeps UF6 out of contact with water.

c. Use of Freon R-11 (not steam or water) to heat and cool enriched product desublimers. This keeps UF6 out of contact with water.

d. Use of air, chilled by Freon R-11 refrigerant (not water), to desublime UF6 and cool enriched uranium cylinders in product blending stations. This keeps UF6 out of contact with water.

e. Use of rockwool and polyurethane foam material with an external vapor seal to prevent moisture buildup in desublimer insulation. This keeps UF6 out of contact with water and prevents buildup of neutron reflector.

Additionally, undesired moderation of UF6 in process systems is prevented by system pressures which are a fraction of the water or HF vapor pressure at operating temperatures. Criticality cannot occur if these two substances remain in gaseous form.

The liquid effluent monitoring tanks, the decontamination tanks and the citric acid collection tanks are located in the Technical Services Area of the Separations Building. These tanks may contain uranium that is collected as a result of decontamination activities, such as UF6 pump maintenance. Criticality is prevented by controlling the uranium mass and concentration in these tanks.

Centrifuges are arranged on end in a square array. Failed centrifuges could take on water vapor as a result of a slow inleakage of air. A criticality analysis was performed and is presented in Section 4.5 of the SAR (Reference 1). The results of this analysis indicate that even for a three by three array of failed centrifuges, the k-eff is less than 0.75. Therefore, even for this highly unlikely scenario, criticality is not possible.

5.1.2.2 <u>Fire</u>

Fires happen occasionally at most industrial plants. It is essentially impossible to prevent fire from ever happening at every point in a facility. Consequently, the CEC design includes a number of provisions to deal with the threat of fire:

a. Preventing fires from starting by segregating ignition sources and by minimizing the quantity of combustible materials in the facility to prevent the spread of potential fires;

b. Using fire resistant building materials to divide the plant into zones. These fire barriers prevent a fire in one zone from spreading to another zone. This complies with NFPA 101 (Reference 2);

c. Using fire detection systems to alert plant operators of fire;

d. Using adequate fire suppression systems, both automatic and manually operated, to extinguish fires; and

e. Fighting significant fires using fire fighting equipment and personnel, including the onsite fire brigade and offsite assistance.

A preliminary fire hazard analysis has been performed. The results indicate that fire does not pose a threat that would cause UF6 to be released. This analysis evaluates the maximum possible fire that could occur in each of the zones enclosed by fire barriers. For each postulated fire, the combustible loading is used to predict the duration of the fire. If the duration of the fire is less than the rating of the barriers surrounding the zone, then it is concluded that the fire cannot spread into another zone. The following is an example of a fire hazards analysis for a typical zone.

The Technical Services Area (TSA) was analyzed because it represents the worst case fire scenario. This is based on the combustible loading of the area and its proximity to the uranium enrichment process. This is the only area where combustion loading could be significant. In performing this analysis, several conservative assumptions were made in order to identify the magnitude of the worst case fire that might arise. It was assumed that:

a. The fire suppression systems would be impaired during the fire;

b. No response would be provided by the fire brigade; and

c. The combustible contents of the individual rooms and/or entire TSA would burn completely.

The analysis indicates that the postulated fire would not penetrate fire barriers and spread into areas where UF6 is processed. A fire in the TSA would not damage or destroy safety class equipment or circuits, and it would not lead to a release of UF6.

Approximately 140 Type 1S UF6 sample bottles are in the TSA. Potential fires in the TSA are not of long enough duration to cause the sample bottles to rupture. Therefore, no UF6 is released to the building as a result of a fire.

The only release of radioactive materials would occur as a result of a fire consuming spent HEPA filters or contaminated solid waste. Small quantities of radioactive materials would be released to the building with only trace amounts released to the atmosphere. There are no measurable consequences.

There are no credible scenarios that would cause a explosion.

5.1.2.3 Natural Phenomena

The CEC is designed to withstand normal natural phenomena (wind, rain, snow, earthquake, etc.) per the requirements of the SBCCI Standard Building Code (Reference 3). In addition, the Separations Building is designed to withstand extreme natural phenomena as described in Section 5.2 of the SAR (Reference 1). These extreme natural phenomena are designated as the Design Basis Earthquake (DBE), Design Basis Tornado (DBT), Design Basis Hurricane (DBH), and Design Basis Flood (DBFL). The consequences of extreme events are described below.

5.1.2.3.1 Earthquake

The CEC DBE has an annual probability of occurrence of 2E-3 (once in 500 years). The maximum horizontal ground acceleration associated with the DBE is 0.046g as determined by Law Engineering and presented in their Seismology Report (Reference 4).

The Separations Building, the autoclaves, the centrifuges, and all System Class I components are designed to withstand the DBE. Other components in the UF6 systems are not specifically designed to withstand the DBE. Should a large earthquake occur, these components could fail and release small amounts of UF6. These releases would result in no measurable consequence.

5.1.2.3.2 Tornado

The DBT considered for this analysis has an annual probability of occurrence of 1E-4 (once in 10,000 years). The characteristics of the DBT as determined by Mehta (Reference 5) are presented in Table 5.1-1, Design Basis Tornado.

The Separations Building is designed to withstand the DBT, thereby preventing a large release of UF6 which could endanger the health and safety of the public. Small releases of UF6 could result from DBT missiles striking the Separations Building. The releases would result in no measurable consequence.

5.1.2.3.3 Hurricane

Hurricane conditions are bounded by normal wind and tornado wind at the CEC, as stated in Section 4.2.2.2 of the SAR (Reference 1). Therefore, there are no releases of UF6 or hazardous chemicals that will occur as the result of a hurricane.

5.1.2.3.4 Flood

The DBFL considered for this accident analysis is the Standard Project Flood (SPF) as defined by the U.S. Army Corps of Engineers. The area around the CEC is designated to be one having minimal flooding potential by the Corps of Engineers. Any flooding at the CEC would be the result of localized intense rainfall.

The local flood analysis is based on the six hour Standard Project Storm as described in Section 3.4 of the SAR (Reference 1). The resulting storm distribution is shown in Table 5.1-B. This storm results in a maximum water depth of 2.5 inches on the CEC yard.

The Separations Building is designed to withstand the buildup of water on the roof. The floor of the Separations Building is located six inches above yard grade, thus providing 3.5 inches of freeboard. Therefore, no release of UF6 or hazardous chemicals can occur from the Separations Building as a result of the Standard Project Flood.

The cylinders of UF6 that are in the various outdoor storage areas will not be affected by the Standard Project Flood. These cylinders are stored on saddles approximately eight inches high. This provides 5.5 inches of freeboard for the average cylinder.

The Cylinder Receipt and Dispatch Building is designed so that water will not accumulate on the roof. The floor is located at an elevation that provides approximately 3.5 inches of freeboard. Therefore, there is no release of UF6 from the Cylinder Receipt and Dispatch Building associated with the SPF.

5.1.2.4 Material Handling - UF6 Cylinders

The CEC cylinder handling system will receive, transport and dispatch over 1400 cylinders per year. The continuous operation of the uranium enrichment process requires the efficient movement of feed cylinders, product cylinders and tails cylinders. These cylinders must be moved from offsite transport vehicles, to storage locations to weigh stations, to and from autoclaves, and to and from take-off stations.

There are three types of equipment that are used to handle UF6 cylinders at the CEC. They are as follows:

a. 25-ton overhead cranes,
b. Rail transporter, and
c. Site transporters.

5.1.2.4.1 Equipment Descriptions

There are two 25-ton overhead cranes at the CEC. One is located in the Cylinder Receipt and Dispatch Building. The second crane is located in the Cylinder Handling Area of the Separations Building. These cranes are used for loading and unloading UF6 cylinders from offsite transport vehicles, moving cylinders to and from weigh stations, loading and unloading cylinders from the rail transporter, and moving cylinders into temporary storage locations.

The rail transporter is located in the Separations Building. It is used for moving UF6 cylinders from the Cylinder Handling Area to and from the autoclaves and take-off stations.

The site transporter(s) is either a modified forklift or a straddle carrier. The site transporter is used for moving UF6 cylinders between the Cylinder Receipt and Dispatch Building, the Cylinder Handling Area of the Separations Building, and the outside storage areas.

5.1.2.4.2 Safety Features

Design features and operating restrictions have been defined for the cylinder handling equipment items, to avoid any UF6 release. The most significant restriction contributing to safe operations is the prohibition against handling cylinders unless they have been cooled and the contents solidified. By restricting cylinder handling to solid UF6, the consequences of a breached cylinder are limited to the very low vaporization and reaction rate of solid UF6.

The LES uranium enrichment facility has both design and operating restrictions to prevent and prohibit the handling and movement of a cylinder with liquid UF6. Liquid UF6 in a cylinder is very dense and tends to shift or "slosh" within the void space of a cylinder. This sloshing can cause rapid shifting of the center of gravity when a cylinder is suspended by the flexible wire ropes of a crane. The results of even small acceleration or deceleration of the crane can make the cylinder difficult to control, thereby increasing the risk of cylinder rupture by puncture or deformation.

Finally, it is important to note that the cylinders, i.e., feed, product, and tails, have all been designed and tested to withstand a severe drop, and even withstand deformation before rupture (Reference 6).

5.1.2.4.3 Operating Experience

With a maximum operating requirement of over 15,000 cylinder moves per year by crane, the probability of an incident resulting in loss of cylinder control cannot be ruled incredible. The assumed failure scenario results in the drop of a cylinder as much as five feet. It is estimated that this could occur once every 75,000 moves. However, this failure will not necessarily result in a release of UF6. In order for there to be a release of UF6, there must be a breach of the cylinder wall. The probability of puncturing a cylinder, given a crane failure and cylinder drop, depends on:

a. Status of the cylinder - empty or full,

b. Height of the drop, and

c. Objects the cylinder may strike.

In developing a prediction of cylinder handling failure rates at the CEC, it is useful to consider the operating history at three European Urenco sites that use the same handling equipment and operating procedures. In a period of approximately thirty-three operating years at three Urenco facilities, and over 100,000 cylinder moves by crane, no cylinder has ever been dropped.

In nineteen years of operating experience at two Urenco facilities, there have been no incidences of a cylinder being dropped from a rail transporter. There have been a few (< 5) cylinders dropped from site transporters during this same time frame. However, none of these incidents resulted in a release of UF6.

5.1.2.4.4 Consequences of Handling Incidents

Releases of UF6 from a cylinder during handling will be unquantifiably small. The UF6 is in a solid state during these operations. There is no measurable consequence.

5.1.2.5 <u>Storage Yard Fire</u>

The postulated event involves exposure of one or more feed or tails UF6 cylinders to an intense heat source. Such an event is very unlikely. A serious fire, lasting more than 30 minutes, is postulated to occur in the immediate vicinity of a cylinder located outdoors. This event could result in the outdoor release of a UF6 cloud. Such an event is considered the worst case accident. This postulated accident is described in detail in Section 9.2.2.3 of the SAR (Reference 1).

This release would be prevented by two factors. First, the cylinders are designed to survive a thirty minute fire (References 7, 8 & 9). Second, LES will use a combination of engineered safety features, such as speed bumps, limited capacity fuel tanks for onsite vehicles, adequate fire protection components, and administrative controls (e.g., excluding combustible materials from storage yards) to prevent a thirty-minute fire from occurring. For example, the Tails Storage Yard is designed to ensure that combustible liquids (e.g., spilled fuel) immediately drain away from the yard areas. Consequently, a hot fire of long duration (e.g., greater than 30 minutes) is not a credible event.

In order for this accident to occur, several other events must occur simultaneously. First, a fire must somehow erupt in the storage yard. Several of the following events must also occur:

a. Failure to follow procedures which limit the amount of combustible materials kept in the storage yard;

b. Failure to follow procedures which limit the amount of combustible materials carried into the storage yard (i.e, vehicles with large fuel tanks);

c. Failure of a vehicle fuel tank or a fuel spill from a fuel delivery truck;

d. Failure of the yard drain system to route a fuel spill away from the cylinders;

e. Failure of the onsite fire brigade to respond to the fire in a timely manner; and

f. Failure of the offsite fire brigade to respond to the fire in a timely manner.

Based on these factors, this accident is not credible. Therefore, there is no release of UF6.

5.1.2.6 <u>Autoclave Heater Malfunction</u>

The potential accident of concern is caused by malfunction of the autoclave heater. The specific details of this postulated accident are presented in Section 9.2.2.2 of the SAR (Reference 1). Essentially, if several control and protection systems simultaneously failed to shut off the heater, the primary and secondary containment could become overpressurized and fail. Rupture of a heated cylinder would spill UF6 into the autoclave. This would quickly produce UF6 gas. If the secondary containment then also failed, UF6 would be released into the building. Postulated events include overheating a feed cylinder, overheating a product cylinder in the liquid sampling or blending autoclaves, or heating an overfilled feed or product cylinder.

Releases due to overheating would be initiated by malfunctions of the heater control circuits, coupled with simultaneous failure of the air pressure/temperature protection systems which are intended to detect malfunctions of the heater control circuits. Heating overfilled containers does not release UF6 to the environment, only into the secondary containment (i.e., the autoclave). For a release to the building to occur, the autoclave heater control circuits and the pressure/temperature protection circuits would also have to fail and operators would have to ignore alarms and fail to take corrective actions.

Hydraulic failure of the cylinder does not directly lead to mechanical failure of the autoclave, which was designed as a secondary containment system. The autoclave has redundant, functionally divergent instrument loops which will trip alarms and automatically shut off the heater under conditions indicative of UF6 releases to the autoclave internal atmosphere. This prevents subsequent mechanical failure of the autoclave secondary containment. There are a total of four instrument loops, two air temperature trip loops and two air pressure trip loops. One air temperature and one air pressure loop have been designated as safety related, System Class I components.

Overpressurization of a cylinder alone cannot cause a failure. Continued overheating is required before failure can occur. Overheating requires multiple failures of the heater control and autoclave protection circuits. The failures required are:

Controller failure	- and
Controller protection system failure	- and
First air temperature trip (hardwired) failure	- and
Second air temperature trip (hardwired) failure	- and
First air pressure trip (hardwired) failure	- and
Second air pressure trip (hardwired) failure	- and
First heater surface element temperature trip failure	- and
Second heater surface element temperature trip failure	- and
Third heater surface element temperature trip failure.	

This failure scenario also conservatively assumes no operator intervention to interrupt power to the autoclave heaters. Simultaneous failure of all these devices is not credible. Therefore, there is no release of UF6.

5.1.2.7 Postulated Abnormal Events

Abnormal events or process upsets could occur as a result of equipment malfunctions and/or operator errors during normal operations. CEC systems and components are designed to prevent or mitigate the consequences of postulated abnormal operations. For the purpose of this discussion, abnormal events include process upsets.

Abnormal events are associated with UF6 operations involving solid or gaseous UF6. The release potential is limited by the physical and chemical properties of UF6. Abnormal operations could potentially lead to small releases of hazardous materials within the facility. The extremely unlikely, but potentially more severe, accidents involving large quantities of readily dispersible liquid UF6, are discussed in Section 5.1.2.6.

Eleven abnormal events are discussed in this section. They are:

a. Centrifuge containment failure,

b. Desublimer pipe rupture,

c. UF6 positive pressure pipe failure,

d. Erroneously opening a contaminated autoclave,

e. UF6 chemical reactions in a cylinder,

f. Hydraulic rupture of UF6 low pressure piping,

g. Chemical trap rupture,

h. Power failure,

i. Water failure,

j. Fluorine leak,

k. Scrubber failure, and

l. Compressor leak.

5.1.2.7.1 Centrifuge Containment Failure

The postulated abnormal event associated with centrifuge operation is mechanical failure of the high speed rotor within the casing of the machine. The specific details of this abnormal event are presented in Section 9.1.1 of the SAR (Reference 1). The postulated causes of centrifuge containment failure are casing penetration by rotor fragments and/or rupture of the floor mounting system after a centrifuge rotor failure. The penetration of rotor fragments could theoretically breach the centrifuge casing, injuring workers and/or releasing small quantities of hazardous material. Rupture of the floor mounting system could potentially result in worker injury and/or damage to adjacent centrifuges. Urenco test data has demonstrated the effectiveness of the TC12 design features that prevent adverse consequences of centrifuge rotor failure. Thus, centrifuge containment failure is not a credible event within the CEC. Therefore, there is no release of UF6.

5.1.2.7.2 Desublimer Pipe Rupture

The specific details of this abnormal event are presented in Section 9.1.2 of the SAR (Reference 1). The only credible failure mode is thermal expansion of solid UF6 in an overfilled desublimer pipe. This failure mode requires that the desublimer be overfilled beyond the operational fill limit of thirteen percent capacity (≈1100 lbs UF6) to at least eighty-eight percent capacity (≈7490 lbs UF6), assuming uniform annular desublimation. Again, it is very unlikely that multiple operator errors over a long period of time could result in overfilling a desublimer by about 700 percent.

In the unlikely event that a desublimer pipe does rupture, the UF_6 contents will be confined by the desublimer casing. Therefore, only trace amounts of uranyl fluoride (UO_2F_2) and hydrogen fluoride (HF) would be released to the building.

Deformation of the desublimer pipe could conceivably damage the Freon coils wrapped around the outside diameter, potentially releasing Freon R11 inside the casing. UF_6 is not reactive with Freon R11. Chemical reactions with moisture would be prevented by the inert nitrogen blanket within the casing. The desublimer casing would confine any release from the desublimer pipe so that only trace amounts of uranyl fluoride (UO_2F_2) and hydrogen fluoride (HF) would be released to the building.

5.1.2.7.3 UF_6 Positive Pressure Piping Failure

The specific details of this abnormal event are presented in Section 9.1.3 of the SAR (Reference 1). The design is such that failure of the piping, connections, and/or valves containing UF_6 under positive pressure (greater than atmospheric) can only occur within the secondary containment of an autoclave. Therefore, postulated single failures associated with these components such as pipe breaks, pigtail failures, or valve leaks cannot result in the release of hazardous materials outside the autoclaves. These abnormal events would result in contamination of an autoclave, which is discussed in Section 5.1.2.7.4.

5.1.2.7.4 Erroneously Opening a Contaminated Autoclave

The specific details of this abnormal event are presented in Section 9.1.4 of the SAR (Reference 1). The failure of a cylinder, piping, connections, and/or valves containing UF_6 under positive pressure would result in contamination within the secondary containment of an autoclave, as described above in Section 5.1.2.7.3. Erroneously opening a contaminated autoclave would expose plant personnel to hazardous materials. In order to occur, this abnormal event would need to be initiated by multiple operator errors associated with the verification of and response to a release of UF_6 inside an autoclave. The autoclaves are provided with design features that effectively protect plant personnel from erroneous autoclave door operation.

The effects and consequences of opening a contaminated autoclave depend on the quantity and phase of the contamination within the autoclave. The accumulation of liquid UF_6 in an autoclave is not credible. Therefore, the autoclave could only contain solid and/or gaseous UF_6 and small quantities of solid UO_2F_2 and gaseous HF at the time of the incident.

Therefore, the quantity of contamination within an autoclave would most likely be limited to that which could accumulate from a small leak in the UF_6 positive pressure piping. In this case, the quantity of UF_6 that could accumulate is limited to the few pounds that could leak before it is detected and alarmed by the increase in the autoclave air pressure/temperature ratio. If this means of detection fails, leakage of approximately 220 lbs UF6 would generate enough vapor pressure in the autoclave volume to trip the System Class I pressure sensors, which would generate alarms and shut down the heaters. The operators would respond to the alarm by manually closing the cylinder's Superior valve. The quantity of UF6 that could ultimately leak is limited to the quantity that would generate enough vapor pressure to equal the pressure inside the leaking cylinder. Thus, the maximum quantity could be slightly more than 220 lbs due to the heat capacity of the UF6.

Contamination would be limited primarily to solid UF6 deposited on surfaces inside the autoclave. The quantity of HF and UO2F2 would be limited before the door is opened because very little moisture is available in the sealed autoclave to react with UF6 at the time of the release. A small quantity of HF and UO2F2 would be produced after the door is opened from the slow reaction between solid UF6 and moisture in the air. The UO2F2 settles out soon after formation. Since solid UF6 has a sub-atmospheric vapor pressure at ambient temperature, any solid UF6 in the cylinder or autoclave would remain in the cylinder or autoclave after cooling.

The autoclave design features that preclude the accumulation of liquid UF6 within an autoclave effectively limit the dispersion of hazardous materials outside the autoclave during erroneous door operation. The autoclave door can only open a few inches before reaching a travel stop that prohibits further movement until it is manually released. Dispersion is also limited and easily detectable by the physical and chemical properties of UF6, UO2F2, and HF. HF has an obnoxious odor and is extremely irritating at concentrations well below the levels required to cause health effects. Therefore, plant personnel would have ample warning to safely evacuate the area after erroneously opening a contaminated autoclave.

5.1.2.7.5 Cylinder Rupture Due to UF6 Reactions

The specific details of this abnormal event are presented in Section 9.1.5 of the SAR (Reference 1). The accident analysis verifies that the cylinders are not affected by credible failures that could introduce hydrocarbons into a UF6 system. There are no credible combinations of failures that could cause a significant quantity of hydrocarbons or water to enter a cylinder during filling. The procedure for inspecting and connecting empty cylinders prevents significant amounts of reactive impurities from remaining undetected in a received cylinder.

The only credible scenario for in-leakage begins with the substitution of a non-volatile hydrocarbon oil for the inert Fomblin oil used in process vacuum pumps. Two simultaneous, major operating errors would have to occur for a hydrocarbon to be substituted for Fomblin oil. First, a hydrocarbon lubricating oil would have to be introduced into the storage area for the Fomblin oil used in process vacuum pumps. This would be a violation of material handling procedures. Second, the maintenance technician would have to mistakenly fill a process vacuum pump with the hydrocarbon oil, despite its different appearance and density. This is a violation of maintenance procedures. Pumps that use Fomblin oil are maintained in a separate area of the pump workshop.

While these types of operator errors cannot be entirely ruled out, these operator errors do not lead to any credible scenario which could result in a significant amount of hydrocarbon entering a cylinder. Since oils have a very low vapor pressure, it is unlikely that significant quantities could traverse through the piping to a cylinder station. Also, the use of hydrocarbon oil in a product or tails vacuum pump would result in alarms and shutdowns for high pressure, high temperature and/or high motor current.

The credible scenarios that were developed do not result in a release of any process materials or reaction products. A credible reaction could occur if greater than 1 lb (but less than 25 pounds) of non-volatile hydrocarbon oil is present in a received cylinder. The cylinder would pass through some of the inspection tests. In this scenario, if the remaining inspections are not done properly, there could be a reaction with 20 lb of UF6. The worst credible event would result in an increase in pressure and temperature that would not exceed the hydrotest pressure of the cylinder. Because the cylinder would not fail in this scenario, there would be no release of UF6.

5.1.2.7.6 Hydraulic Rupture of UF6 Low Pressure Piping

The specific details of this abnormal event are presented in Section 9.1.6 of the SAR (Reference 1). Because all UF6 piping outside the autoclaves contains gaseous UF6 under vacuum, the only scenario that can rupture UF6 low pressure piping is a heat tracing/hot box failure that allows UF6 to desublime inside the pipe, combined with a subsequent operator error which allows the pipe to be reheated before the solid UF6 is evacuated.

The following sequence of faults must occur before a release of UF6 is possible:

a. Failure of the heat tracing and/or hot box heater circuit, or loss of primary and standby power supply to the heaters, or operator error that erroneously de-energizes heaters

b. Failure of the temperature sensor and/or alarm in the heater circuit that controls temperature. This is independent of the above failure because the heater and sensors receive power from different sources

c. Failure of the temperature sensor and/or alarm in the independent protection circuit.

d. Failure of the pressure and/or flow instrumentation to alarm in response to changes in these parameters associated with the formation of a flow restricting plug. Note that this failure does not apply to lines in which there is no flow such as isolated branch connections

The above failures would allow UF6 to desublime in the pipe or component. At least three independent failures must occur to form a plug due to UF6 desublimation In addition, the following events must occur before liquefaction of UF6 could rupture the pipe:

e. The operator erroneously re-energizes the heat tracing and/or hot box heater before evacuating the desublimed UF6. The operator could also fail to de-energize an inadvertent restoration of power before evacuating the desublimed UF6. Note that this fault is not necessarily independent of (a), (b), and (c) above because the operator would not be aware of the potential for a problem if the alarms failed.

The three independent faults listed above (a, b, & c) could potentially lead to pipe rupture in the Blending Facility because the Product Blending System operates at 176 F, which is above the triple point of UF6. Yet another fault would have to occur before a release would be possible in the 140 F systems:

f. Failure of the temperature controller that allows the UF6 temperature to exceed 147 F, the triple point of UF6.

At least four faults would be required before a release of hazardous material from the 140 F systems would be possible. The 140 F systems are located in the UF6 Handling Areas. At least three faults would be required before a release of hazardous material would be possible in the Blending Facility. Therefore, since more than two unlikely, independent failures must occur, hydraulic rupture of the low pressure UF6 piping is not a credible event within the CEC. Therefore, there is no release of UF6.

5.1.2.7.7 Chemical Trap Rupture

The postulated abnormal event associated with chemical trap operation involves a chemical reaction between UF6 and carbon, which could produce explosive reaction products. The specific details of this abnormal event are described in Section 9.1.7 of the SAR (Reference 1). These reaction products could theoretically ignite, endangering plant personnel and/or releasing hazardous materials.

The postulated cause of chemical trap rupture depends upon the desublimer operating mode at the time of the incident. The following sequence of faults must occur to cause a chemical trap rupture when the desublimer is operating in the on-line, standby, or purification modes (cold Freon modes).

a. The hot freon supply valve to the desublimer fails open. As a result, a hot desublimer containing UF6 is connected to the vent system with the vent pump operating. Failure of this valve in the open position is very unlikely because it is a fail close valve.

b. The flow switch in the hot freon supply line fails to shut down the vent vacuum pump in response to (a) above.

Under these conditions, the adsorption of UF6 on the activated carbon bed of the chemical trap would cause the temperature of the bed to rise sharply over a period of several minutes, evolving several pounds of carbon monoxide. The sharp temperature rise in the chemical trap would exceed its design temperature and cause it to expand, which could in turn cause it to fail mechanically. Thus, air in-leakage is assumed to occur which could produce an explosive mixture of CO and oxygen. This mixture is assumed to ignite due to either a static spark in the bed, a spark from the vacuum pump, or auto-ignition.

Since at least two unlikely, independent failures must occur, the explosive rupture of a chemical trap is not credible during the on-line, standby, or purification modes of operation.

Note that the vent vacuum pump normally operates during the on-line, standby, and purification modes evaluated above. During the heat and gas-over modes (hot freon modes), the vacuum vent pump does not operate. Therefore, if the desublimer outlet valve fails open (unlikely, this is a fail closed valve), very little UF6 would transfer from the desublimer to the chemical trap because the pressure in the desublimer and the chemical trap would equalize. The reaction would be self-limiting because the generation of heat within the chemical trap would establish a temperature gradient. If the chemical trap failed mechanically due to the temperature rise, very little air could enter the trap before the closed volume within the desublimer and chemical trap reached atmospheric pressure. Therefore, there are no credible circumstances by which an explosive mixture could be formed within a chemical trap during the heat and gas-over modes of operation. Therefore, there is no release of UF6.

5.1.2.7.8 Power Failure

The CEC electrical system is described in detail in Section 6.4.2 of the SAR (Reference 1). The main source of supply of electrical power for the CEC is derived by means of two 11 kV overhead transmission lines coming from two different substations from the Louisiana Power and Light Utility grid. Each line is rated to supply the total power requirements of the facility.

Redundant incoming power supply lines are used to assure continuous power supply to the CEC. In case one line is taken out of service for the purposes of maintenance or fault rectification, the second line continues to provide power without any disruption to the facility operation.

The overall power distribution system is designed to maintain a reliable power supply to the process equipment. Loss of power has no effect on worker safety or the health and safety of the public. An extended loss of power could result in centrifuge failure which endangers the economic investment made by LES. The process load requirements for the CEC are categorized as either non-essential, essential or critical. The non-essential loads are associated with systems and equipments which are not vital to the efficient operation of the CEC.

The essential loads are associated with the following:

a. Product and tails high pressure vacuum pumps

b. Product and tails low pressure vacuum pumps

c. Pipe electric heat tracing

d. Hot box heaters

e. Uninterruptible Power Supply

f. Air fan motor for Air Cooling Product Containers System

g. Air compressor and dryer in Plant/Instrument Air System

h. Air fan motor in Gaseous Effluent Vent System

i. Diesel fuel tank pump motor for Standby Generator System

j. Circulation pump motors in Hot and Cold Refrigerant Systems

k. Communication System

l. Electrical outlets for mobile pump sets

The above essential loads are fed from the essential load motor control centers, which have back-up power from the standby diesel generators.

The critical loads are associated with the following:

a. Computer System

b. Instrument Power Supply

c. Contingency Dump Vacuum Pumps

d. Emergency Lighting

All of the above critical loads are fed from the Uninterruptible Power Supply (UPS) bus. The UPS is normally fed from the essential load switchgear. Each UPS battery back-up system is designed to supply power for a period of time sufficient for an orderly plant shutdown on total loss of offsite and onsite power.

The UPS receives power input from four sources. These include two incoming offsite power sources, the standby diesel generators and stationary batteries. All power inputs to the UPS transfer automatically to another source if the first source fails. Therefore, any load that is connected to the UPS is unaffected by loss of offsite power and standby diesel generator failure.

The design of the power distribution system for the CEC provides for a reliable source of power to process equipment. In the highly unlikely scenario that offsite power is lost and the standby diesel generators fail to come on line, the UPS will provide power to the critical loads for an amount of time sufficient to shut the plant down in an orderly manner. This highly unlikely event does not cause any other failures to occur that would release hazardous materials.

5.1.2.7.9 Water Failure

The various water systems at the CEC are described in Sections 6.4.5 and 6.4.6 of the SAR (Reference 1). The primary concern with water failures is the potential for a criticality accident if water mixes with UF6. The CEC design provides multiple barriers between water and UF6 so that a single failure cannot bring water and UF6 into direct contact. The only places where this is not true are the tails take-off stations and the feed purification station. The enrichment levels of the UF6 at these locations is at or below that of naturally occurring uranium. The 48 inch cylinders used in these locations are criticality safe by geometry at these enrichment levels. Therefore, no release of hazardous material can occur as the result of a water failure.

5.1.2.7.10 Fluorine Leaks

Fluorine is not used at the CEC.

5.1.2.7.11 Scrubber Failure

The CEC does not utilize scrubbers.

5.1.2.7.12 Compressor Leaks

This type of accident is of concern at uranium enrichment facilities utilizing the gaseous diffusion process. It is not a concern at the CEC. All UF6 compressors in the CEC operate at subatmospheric pressure. Therefore, leaks are inward and releases of UF6 would be very small.

5.1.3 POTENTIAL EVENTS INVOLVING MATERIALS OTHER THAN UF6

This section of the accident analysis concentrates on the accidental release to the environment of solid, liquid, and gaseous chemicals other than UF6. Tables 5.1-3, 5.1-4, and 5.1-5 present the variety and quantity of chemicals that are used and stored at the CEC. The estimated inventories include in-process quantities and stored quantities as appropriate. All chemicals are handled and stored in accordance the appropriate regulations and industrial codes.

The computer program ARCHIE (Automated Resource for Chemical Hazard Incident Evaluation), which is part of the Handbook of Chemical Hazard Analysis Procedures (Reference 10), has been used in assessing the various postulated chemical releases that are presented later in this section. The primary purpose of ARCHIE is to provide emergency response personnel with several integrated estimation methods that may be used to plan for the consequences of the vapor dispersion, fire, and explosion impacts associated with episodic discharges of hazardous materials into the environment. The program is also intended to facilitate a better understanding of the nature and sequence of events that may follow an accident and their resulting consequences.

The core of the ARCHIE computer program is a set of hazard assessment procedures and models that can be sequentially utilized to evaluate consequences of potential discharges of hazardous materials and thereby assist in the development of a basis for emergency planning.

ARCHIE was selected from a number of EPA/DOT endorsed programs, including AIRDOS, COMPLY, ISCST, INPUFF and PLUME. ARCHIE was selected from among these programs for its integrated approach to the hazardous chemicals release. This program's procedures are simplified versions of the more complex (and more difficult to use) methods employed by other programs. ARCHIE was intended to provide estimates and approximate answers sufficient for general planning. Conservative in its approach, ARCHIE will usually produce results that overestimate hazards.

This analysis focuses on the potential for environmental contamination as a result of spillage or release of hazardous chemicals. The inventory of most hazardous chemicals is limited to what is consumed on an annual basis. These inventories tend to be less than ten gallons per chemical. The releases that have been analyzed for offsite environmental consequences are as follows:

a. Freon (R-11, R-12, R-13, R-22, and TF)

b. Methanol

c. Acetone

d. Perchloroethylene

5.1.3.1 Release Scenarios

Reasonable scenarios were created for the release of fluorotrichloromethane (R-11), trichlorotrifluoroethane (TF, a solvent), methanol, acetone and perchloroethylene. The R-11 refrigerant is located primarily in pressurized tanks in the Separations Building. The solvents are stored safely in appropriate containers within the Centrifuge Assembly Building.

The release to the environment can be affected by the ambient meteorological conditions. Worst-case conditions (i.e., those resulting in high off-site concentrations) occur under a Pasquill-Gifford stability class F (highly stable) with 5 mph winds. An average case has also been used. The average case is stability class C (unstable) with 9 mph winds (9 mph is the average wind speed at Shreveport, LA, which is located nearby).

All of the accidents were assumed to occur outdoors. This choice is conservative since all of the materials will be stored and handled indoors and will be at least partially contained by a building. It was not possible to model an indoor release with the ARCHIE model.

The objective of these calculations was to determine the maximum off site atmospheric concentration of each chemical. The maximum concentration usually occurs at the fenceline. Unfortunately, ARCHIE can only calculate the distance at which the concentration of the substance goes below some predetermined 'safe' level. To get fenceline concentrations of each chemical, the 'safe' concentration was set artificially low and the model results (concentration versus distance) were interpolated to estimate fenceline concentrations.

For the R-11 releases, the hypothetical scenario is that a valve or a line into the expansion vessel of the refrigeration system is broken off resulting in a two-inch hole. The two-inch hole was assumed to be at the bottom of the tank so that the release was at ground level. Since R-11 is a denser-than-air gas, it will subside to the floor before mixing with the ambient air. Hence, even if the hole was at the top of the tank, the vapor plume would descend to the floor before dispersing into the air.

Only the contents of the vessel are assumed to be available for release, and it is assumed that the release can be halted in at least 30 minutes. The R-11 is kept primarily in three refrigeration systems: a hot system, a cold system and a refrigerant supply system. The main component of all three systems, with respect to a hazardous release, is the expansion vessel. For the hot and cold systems, the expansion vessels are at a temperature of 131 F and at a pressure of 25 psig. The supply system is at ambient temperature (75 F) and a pressure of 5 psig.

The boiling point of R-11 is 74.7 F, or approximately equal to the ambient temperature. Hence, there are two mechanisms by which the R-11 can be released: boiling off of the liquid within the container and pressurized release from the tanks. Part of the modelling effort was to ascertain which release mechanism is dominant for each accident. The pressurized release will occur for all three systems, at a greater rate for the hot and cold systems since they are at higher pressures. The R-11 may also boil out of the expansion vessels of the hot and cold systems since they are at elevated temperatures. The chemical properties that determine the rate of evaporation were taken from Verschueren (Reference 11). The supply system is at ambient temperature, so it is assumed that boiling and rapid evaporation of the R-11 in the supply system is not the dominant release mechanism.

For the releases of the four solvents, it was assumed that the maximum inventory of the solvent at the facility is spilled onto an impermeable floor and allowed to evaporate at ambient conditions. A maximum release time of 30 minutes was allowed to account for timely spill cleanups. The maximum inventories of the four solvents are provided in Table 5.1-3, Estimated Inventory of Chemicals, Separations Building Except TSA. The chemical properties that determine the rate of evaporation were taken from the Handbook of Environmental Data on Organic Chemicals (Reference 11). The ambient conditions are the same as for the R-11 releases.

5.1.3.2 Modeling Results

With the two stability/wind speed conditions, the four solvent release scenarios, and the three R-11 release scenarios (two of which have two mechanisms for release), there was a total of 18 model runs. The inputs to these model runs are summarized in Table 5.1-6 Chemical Releases Resulting from Postulated Accidents. The results are also tabulated in Table 5.1-6. The site boundary concentrations are noted in this table and the STEL (the Short Term Exposure Limits of the American Conference of Governmental Industrial Hygienists) are tabulated where available.

The STEL is not exceeded offsite during any of the release scenarios. In fact, it is often the case that the STEL is never exceeded. The choice of the STEL to determine the hazard from the chemical releases is very subjective. There are other health-based and environmental protection criteria that can be used and these are presented in the next section.

5.1.3.3 Assessment of the Environmental and Health Impacts of the Chemical Release Accidents

For the accident scenarios discussed in the previous section, only acute inhalation exposures are of concern with respect to the health and environmental impacts of the releases. This is because the releases will not result in long periods of elevated levels in the environment. All of the chemicals that have been considered are volatile at ambient conditions, so they will not be deposited on surfaces. They do not pose a threat to any bodies of water because of the amounts that may be released, because of the properties of the chemicals, and because of the brief period of time involved for the plume dispersion. Methanol and acetone are photochemically active and will be destroyed within a day or two in the air. Likewise, perchloroethylene is photochemically active, albeit less so, and there is the added concern that perchloroethylene is a carcinogen. The freons are well known for their non-reactivity in the lower atmosphere, and their potential impact on stratospheric ozone. However, once again, the amount being released is small.

There are many published impact criteria that can be compared to the environmental levels that have been predicted. These include the IDLH, the STEL, the TWA-TLVs, PELs and RELs. The IDLH is a level that is Immediately Dangerous to Life and Health. IDLHs are set by NIOSH (the National Institute of Occupational Safety and Health). The IDLH is defined as a level to which an individual can be exposed without experiencing any escape impairing or irreversible health effects within 30 minutes. The STEL is a Short Term Exposure Limit set by the ACGIH (the American Conference of Government Industrial Hygienists) and is based on occupational exposure and human health criteria. TWAs/TLVs are Time-Weighted Average Threshold Limit Values, also set by the ACGIH. TWAs/TLVs are for occupational exposure and are interpreted as safe limits for everyday exposure (i.e., 8 hours per day, 5 days per week). PELs are Permissible Exposure Limits that are part of OSHA, the Occupational Health and Safety Act. PELs are legally enforceable limits on concentrations in the workplace and are defined similar to the TWAs/TLVs. RELs (Recommended Exposure Limits) are the safe occupational exposure concentrations determined by NIOSH.

The State of Louisiana has a policy for hazardous air pollutants which are defined as Acceptable Ambient Concentrations. The Louisiana program is designed to address chronic exposure beyond the fenceline of the facility. The present analysis is for acute exposures only. The acceptable ambient air concentrations are defined as an annual average of 1/42nd of the ACGIH TWAs/TLVs.

The most appropriate reference concentrations to use for comparison with offsite concentrations during an accidental release situation would be the IDLHs. IDLHs are regulatory standards developed to address acute exposure from sudden releases to workers in the immediate vicinity, who have the opportunity to escape from the situation. They, however, may not protect workers or nearby residents who do not have the ability to escape on short notice, therefore, more conservative values should be considered. These include occupational ceiling limits, STELs and information on minimal sensory effects. For the purposes of planning for releases all regulatory values need to be considered. A summary of reference concentrations for methanol, acetone, perchloroethylene, and the freons is presented below with additional information regarding toxic effects and criteria.

<u>Acetone</u>

Inhalation of high concentrations of acetone vapors causes dryness of the mouth and throat, dizziness, nausea, uncoordinated movements, drowsiness, and in extreme cases, death.

ACGIH TLV TWA	-	750 ppm (1780 mg/m3)
TLV STEL	-	1000 ppm (2375 mg/m3)
OSHA PEL	-	1000 ppm
NIOSH REL	-	590 mg/m3
IDLH	-	20,000 ppm

Toxicity Values

TCLO	500 ppm	- Human, sensory organ
TCLO	440 µg/m3, 6 min	- Human, brain effects
TCLO	12000 ppm, 4 hrs	- Human, gastrointestinal

<u>Methanol</u>

At high doses, exposure to methanol can cause headaches, blurred vision, eventually leading to blindness and death. Even after recovery from initial life threatening exposures, permanent blindness may eventually result.

ACGIH TLV-TWA	-	200 ppm (260 mg/m3)
TLV-STEL	-	250 ppm (310 mg/m3)
OSHA PEL	-	200 ppm
NIOSH REL	-	800 ppm for 15 min
IDLH	-	25,000 ppm

Toxicity Values

TCLO	86,000 mg/m3	- Human, irritation
TCLO	300 ppm	- Human, headache, visual field changes

<u>Perchloroethylene</u>

Excessive exposure to perchloroethylene has resulted in effects on the central nervous system, mucous membranes, eyes and skin, and to a lesser extent the lungs, liver and kidney. Unconsciousness, dizziness, headaches, vertigo, or light narcosis has been reported with occupational exposure.

ACGIH	TLV-TWA	- 50 ppm (340 mg/m3)
	TLV-STEL	- 200 ppm (1320 mg/m3)
OSHA	PEL	- 100 ppm (670 mg/m3)
	Ceiling	- 200 ppm
EPA	B2 Carcinogen	

Toxicity Values

TCLO	96 ppm/7H	- Human, peripheral nerve sensitization
TCLO	600 ppm/10 min	- Human, irritation, anesthetic

Freon 11 and TF

Acute exposure to Freons has been reported to result in irritation to sensory organs. They have a weak narcotic effect and have been reported to have cardiac sensitization properties. At extremely high doses of Freon, experimental animals experienced tremors, convulsions, seizures and death.

ACGIH	Ceiling	- 1000 ppm
OSHA	PEL	- 1000 ppm (5600 mg/m3)
	Ceiling	- 1000 ppm
NIOSH	IDLH (R-11)	- 10,000 ppm
	(Freon-TF)	- 4500 ppm

Toxicity Values

TCLO	R-11	- 50,000 ppm/30 min Human sensory irritation

Based on the results presented in Table 5.1-6, the postulated accidents involving the release of chemicals, other than UF6, do not have any adverse impact on the public or the environment.

REFERENCES FOR SECTION 5.1

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3. Southern Building Code Congress International, Inc., Standard Building Code, SBCCI, 1988 Edition.

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6. Geffen, C.A., et al., "Assessment of the Risk of Transporting Uranium Hexafluoride by Truck and Train," PNL 2211, Pacific Northwest Laboratory, Batelle, August 1978.

7. Uranium Hexafluoride - Safe Handling, Processing, and Transporting, Conference Proceedings, May 24-26, 1988, Oak Ridge, Tennessee.

8. Mallett, A.J., "Container Test and Development Program Fire Tests of UF6 Filled Cylinders", K-D-1984, Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, January 12, 1966.

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10. Federal Emergency Management Agency, U.S. Department of Transportation & U.S. Environmental Protection Agency, Handbook of Chemical Hazard Analysis Procedures.

11. Verscheuren, K., Handbook of Environmental Data on Organic Chemicals, 2nd Edition, Van Nostrand Reinhold, New York, New York, 1983.

Table 5.1-1

Design Basis Tornado

Annual probability	1×10^{-4}
Design wind speed Gust Fastest-mile	 132 mph 115 mph
Radius of damaging winds	248 ft
Atmospheric pressure change	-40 psf
Rate of atmospheric pressure change	-20 psf/sec
Missiles 2" x 4" timber, 15 lbs Horizontal speed Vertical height Vertical speed 3" diameter steel pipe, 75 lbs Horizontal speed Vertical height Vertical speed	 100 mph 150 ft 70 mph 50 mph 75 ft 35 mph

Table 5.1-2

Rainfall Distribution for Standard Project Storm

TIME	INCREMENTAL RAINFALL		ACCUMULATED RAINFALL	
(HOURS)	(Percent)	(Inches)	(Percent)	(Inches)
1	8	1.7	8	1.7
2	15	3.1	23	4.8
3	47	9.9	70	14.7
4	14	2.9	84	17.6
5	8	1.7	92	19.6
6	8	1.7	100	21.0

Table 5.1-3

Estimated Inventory of Chemicals, Separations Building Except TSA

Chemical(s)	Inventory (Approx)	Physical Form(s) Toxicity/Waste
Activated charcoal	600 lbs	Solid, non-toxic, hazardous waste
Activated alumina	600 lbs	Solid, non-toxic, hazardous waste
Fomblin oil	80 gal	Liquid, non-toxic, hazardous waste
Biocide	10 gal	Liquid, toxic
Corrosion inhibitor	10 gal	Liquid, toxic
Anion/cation resin(s)	120 ft^3	Solid, non-toxic
Silica gel	1 ft^3	Solid, non-toxic
Lubricants	100 gal	Liquid, non-toxic, flammable
#2 Diesel fuel	20,000 gal	Liquid, non-toxic, flammable
Freon R-11 refrigerant	2,800 gal	Liquid, non-toxic, non-flammable
Freon R-12 refrigerant	500 gal	Liquid, non-toxic, non-flammable
Freon R-13 refrigerant	1,000 gal	Liquid, non-toxic, non-flammable
Freon R-22 refrigerant	500 gal	Liquid, non-toxic, non-flammable
Nitrogen	10,000 gal	Liquid, non-toxic, non-flammable
Sodium fluoride	168 ft^3	Solid, toxic, hazardous waste
Demineralized water	4,000 gal	Liquid, non-toxic

Table 5.1-4

Estimated Inventory of Chemicals, Technical Services Area

Chemical(s)	Inventory (Approx)	Physical Form(s) Toxicity/Waste
Charcoal, activated carbon	30 ft^3	Solid, non-toxic, hazardous waste
Bleach, detergent	10 gal 200 lbs	Liquid, non-toxic, hazardous waste
Fomblin oil	230 gal	Liquid, non-toxic, hazardous waste
Biocide	10 gal	Liquid, toxic
Corrosion inhibitor	10 gal	Liquid, toxic
Anion/cation resin(s)	120 ft^3	Solid, non-toxic
Silica gel	1 ft^3	Solid, non-toxic
Lubricants	100 gal	Liquid, non-toxic, flammable
Petroleum oil	55 gal	Liquid, non-toxic
Freon TF	400 gal	Liquid, non-toxic
Acetylene	100 ft^3	Gas, flammable
Oxygen	100 ft^3	Gas, flammable
Argon	200 ft^3	Gas
Carbon tetrachloride	50 gal	Liquid, hazardous, toxic, non-flammable
Sodium chloride	1,000 lbs	Solid, non-toxic
Tributyl phosphate	50 gal	Liquid, toxic
Toluene	50 gal	Liquid, toxic, flammable
Dihexylacetamide	50 gal	Liquid, hazardous waste
Lab chemicals	50 gal	Hazardous, toxic

Table 5.1-5

Estimated Inventory of Chemicals, Centrifuge Assembly Building

Chemical(s)	Inventory (Approximate)	Physical Form(s) Toxicity/Waste
Freon TF	1,322 lbs	Liquid, non-toxic, non-flammable
Fomblin oil	8 gal	Liquid, non-toxic, hazardous waste
Hydrofluoric acid, HF	< 1 gal	Liquid, toxic, hazardous waste
Methanol	66 lbs	Liquid, toxic, flammable
Perchloroethylene	44 lbs	Liquid, toxic, flammable
Acetone	220 lbs	Liquid, toxic, flammable

Table 5.1-6 (Page 1 of 4)

Chemical Releases Resulting from Postulated Accidents

RUN #	1	2	3	4	5
INPUTS					
Chemical Released	R-11 (Supply)	R-11 (Supply)	R-11 (Hot)	R-11 (Hot)	R-11 (Hot)
Release Mechanism	Pressurized Release	Pressurized Release	Pressurized Release	Pressurized Release	Boiling Release
Amount Available for Release	6758 lbs (exp ves cap)	6758 lbs (exp ves cap)	6758 lbs (exp ves cap)	6758 lbs (exp ves cap)	6758 lbs (exp ves cap)
Release Duration Limit	30 min	30 min	30 min	30 min	30 min
Ambient Temperature	76 F	76 F	76 F	76 F	76 F
Wind Speed	5 mph	9 mph	5 mph	9 mph	5 mph
Stability Class	F	C	F	C	F
Material Temperature	75 F	75 F	131 F	131 F	131 F
Discharge Height	0 ft	0 ft	0 ft	0 ft	0 ft
RESULTS					
Amount Discharged	6758 lbs	6758 lbs	6758 lbs	6758 lbs	6758 lbs
Discharge Duration	3.75 min	3.75 min	1.77 min	1.77 min	0.414 min
Approximate Fenceline Conc.	3507 ppm	149 ppm	106601 ppm	307 ppm	29110 ppm
Approx. Distance to STEL	N/A	N/A	N/A	N/A	N/A

Table 5.1-6 (Page 2 of 4)

Chemical Releases Resulting from Postulated Accidents

RUN #	6	7	8	9
INPUTS				
Chemical Released	R-11 (Hot)	R-11 (Cold)	R-11 (Cold)	R-11 (Cold)
Release Mechanism	Boiling Release	Pressurized Release	Pressurized Release	Boiling Release
Amount Available for Release	6758 lbs (exp ves cap)	7523 lbs (exp ves cap)	7523 lbs (exp ves cap)	7523 lbs (exp ves cap)
Release Duration Limit	30 min	30 min	30 min	30 min
Ambient Temperature	76 F	76 F	76 F	76 F
Wind Speed	9 mph	5 mph	9 mph	5 mph
Stability Class	C	F	C	F
Material Temperature	131 F	131 F	131 F	131 F
Discharge Height	0 ft	0 ft	0 ft	0 ft
RESULTS				
Amount Discharged	6758 lbs	7523 lbs	7523 lbs	7523 lbs
Discharge Duration	0.414 min	1.97 min	1.97 min	0.46 min
Approximate Fenceline Conc.	968 ppm	6790 ppm	338 ppm	28735 ppm
Approximate Distance to STEL	N/A	N/A	N/A	N/A

Table 5.1-6 (Page 3 of 4)

Chemical Releases Resulting from Postulated Accidents

RUN #	10	11	12	13	14
INPUTS					
Chemical Released	R-11 (Cold)	Methanol	Methanol	Acetone	Acetone
Release Mechanism	Boiling Release	Pool Evaporation	Pool Evaporation	Pool Evaporation	Pool Evaporation
Amount Available for Release	7523 lbs (exp ves cap)	66 lbs	66 lbs	220 lbs	220 lbs
Release Duration Limit	30 min	none	none	none	none
Ambient Temperature	76 F	76 F	76 F	76 F	76 F
Wind Speed	9 mph	5 mph	9 mph	5 mph	9 mph
Stability Class	C	F	C	F	C
Material Temperature	131 F	76 F	76 F	76 F	76 F
Discharge Height	0 ft	0 ft	0 ft	0 ft	0 ft
RESULTS					
Amount Discharged	7523 lbs	66 lbs	66 lbs	220 lbs	220 lbs
Discharge Duration	0.46 min	180 min	116 min	30 min	39 min
Approximate Fenceline Conc.	1038 ppm	3.3 ppm	0.21 ppm	18 ppm	1.22 ppm
Approximate Distance to STEL	N/A	295 ft	< 33 ft*	490 ft	< 33 ft*

* The minimum computable answer is 33 ft. The concentrations within 33 ft of the spill cannot be calculated.

Table 5.1-6 (Page 4 of 4)

Chemical Releases Resulting from Postulated Accidents

RUN #	15	16	17	18
INPUTS				
Chemical Released	Perchloro-ethylene	Perchloro-ethylene	Freon-TF	Freon-TF
Release Mechanism	Pool Evaporation	Pool Evaporation	Pool Evaporation	Pool Evaporation
Amount Available for Release	44 lbs	44 lbs	1320 lbs	1320 lbs
Release Duration Limit	none	none	none	none
Ambient Temperature	76 F	76 F	76 F	76 F
Wind Speed	5 mph	9 mph	5 mph	9 mph
Stability Class	F	C	F	C
Material Temperature	76 F	76 F	76 F	76 F
Discharge Height	0 ft	0 ft	0 ft	0 ft
RESULTS				
Amount Discharged	44 lbs	44 lbs	1320 lbs	1320 lbs
Discharge Duration	302 min	166 min	27 min	17.2 min
Approximate Fenceline Conc.	0.20 ppm	< 0.05 ppm	69.1 ppm	4.6 ppm
Approx Distance to STEL	< 33 ft*	< 33 ft*	N/A	N/A

* The minimum computable answer is 33 ft. The concentrations within 33 ft of the spill cannot be calculated.

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5.2 TRANSPORTATION ACCIDENTS

Outlined below are the potential environmental effects from a spectrum of transportation accidents involving radioactive and non-radioactive materials transported to and from the facility in significant quantities. The following materials have been evaluated:

a) Uranium Hexafluoride (UF6),
b) Diesel Fuel,
c) Sodium Hydroxide,
d) Welding Gases,
e) Sodium Fluoride,
f) Citric Acid, and
g) Chlorofluorocarbons.

5.2.1 URANIUM HEXAFLUORIDE (UF6)

Uranium Hexafluoride (UF6) is transported to and from the site in substantial quantities. Approximately 160,000 pounds of UF6 is transported to the facility and approximately 30,000 pounds of UF6 is transported from the facility each week. The UF6 is transported in cylinders designed and fabricated in accordance with American National Standard (ANSI) N14.1-1987, "Uranium Hexafluoride - Packaging for Transport." UF6 is always transported in solid form. The cylinders used to transport feed UF6 to the facility can carry a maximum of 27,560 pounds. The cylinders used to transport product UF6 from the facility can carry a maximum of 5,020 pounds. Two feed cylinders or five product cylinders may be transported by one truck at a time. Therefore, it is possible to have 55,120 pounds of UF6 being transported on any one vehicle.

The principal hazard associated with UF6 is that it readily combines with moisture in the atmosphere to form uranyl fluoride and hydrogen fluoride. The chemical reaction equation is shown below.

$$UF_6 + 2\ H_2O \longrightarrow UO_2F_2 + 4\ HF$$

This chemical reaction also produces small amounts of heat. Both the uranyl fluoride (UO2F2) and the hydrogen fluoride (HF) are health hazards when inhaled. Hydrogen fluoride gas presents a danger which is chemical in nature only, while the effects of inhaling UO2F2 are both chemical and radiological. However, for UF6 releases involving material with an enrichment of less than 10% U-235, the chemical toxicity is generally considered a far greater threat than the radiotoxicity (Reference 1).

Hydrogen fluoride gas presents a danger which is chemical in nature and has the potential for injurious effects for people, animal life and vegetation. Much has been written concerning the health effects of HF on humans; however, precise quantification of these effects is difficult. Hydrogen fluoride gas causes sever irritation to the eyes and respiratory system. If sufficient quantities of the gas are inhaled, death from pulmonary edema can occur. HF damage is a function of both the concentration of gas inhaled and the duration of exposure. Table 5.2-1, Health Effects of HF, gives reported values for health effects of HF (Reference 2).

Uranyl fluoride presents both a chemical and radiological hazard. The chemical effect of UO2F2 mainly involves the toxicity of uranium. Unlike HF gas, the greatest damage from UO2F2 is caused by the effects of the uranium on the renal system.

The maximum permissible concentration (MPC) of uranium is 0.210 mg/m3. Limits based on soluble uranium were assumed to apply to UO2F2. The International Commission of Radiological Protection (ICRP) gives a value of 2.5 mg inhaled as acceptable. Ten mg inhaled is suggested as a maximum emergency planned occupational dose. A case history at a non-Urenco facility of 13 mg of UO2F2 inhaled resulted in several days hospitalization, with recoverable effects. Little information is available on fatal inhalation levels. One hundred mg inhaled UO2F2 is assumed to result in eventual death. Table 5.2-2 gives the UO2F2 levels and effects assumed for this study.

The case of a cylinder being exposed to fire has been analyzed. The postulated event involves exposure of one or more feed or tails UF6 cylinders to an intense heat source. Such an occurrence is very unlikely. Both the Department of Transportation and the Department of Energy have analyzed the failure of cylinders subjected to fires. Cylinders may rupture when totally immersed in a 30-minute fire. A cylinder cannot rupture in a fire lasting less than 30 minutes.

The accident analysis assumes that one or more cylinders are immersed in a fire lasting 30 minutes or longer. When the cylinder wall reaches a temperature of 1600 F, a breach can occur. UF6 would be released in gaseous and liquid form. This event has been analyzed in NUREG-1140. Results indicated that such an event, if it were to occur, could endanger public health and safety.

5.2.2 DIESEL FUEL

The facility uses diesel engines sized to produce approximately three megawatts of electricity. The diesel engines are used only in the event of a loss of offsite power and during periodic testing. Therefore, the diesel engines are run infrequently.

If a truck delivering diesel fuel were to have an accident, it could release diesel fuel oil to the environment. Diesel fuel contains compounds that are potentially toxic, carcinogenic and soluble in water. If a large spill were to occur, the diesel fuel could kill plants and animals in the immediate area. Also, by entering the groundwater, air, and soil, the diesel fuel could be ingested and/or inhaled by humans. The potential harmful effects to humans are very dependent on the proximity of drinking water sources and the occurrence of inhalation of the diesel fuel or contact with soil contaminated with the diesel fuel by plants, animals or humans (Reference 4).

5.2.3 SODIUM HYDROXIDE

Sodium hydroxide is used at the facility to control the pH of equipment decontamination wastewater. The sodium hydroxide is transported to the facility in powder form and then mixed with water.

If a release of sodium hydroxide were to occur during transportation, it would hydrolyze with any surrounding water or rainfall. Because of the increased pH of the resulting mixture, damage could occur to plants in the immediate area of the spill and to any animals or humans if the solution were ingested (Reference 4). The effects of the spill would be confined to the immediate area of the spill. The dry powder would be recovered by shoveling and/or using vacuum equipment. Dissolved sodium hydroxide would be in-situ neutralized with an acid solution. The Environmental Protection Agency requires the reporting of a release of sodium hydroxide in excess of 1000 pounds (Reference 3).

5.2.4 WELDING GASES

During construction and to a lesser extent during operation, welding gases are used at the facility for construction of piping systems, pipe support systems and other maintenance activities. If improperly handled the compounds associated with welding can be explosive. If during transport to the facility, an accident occurred, an explosion could result. The damage to the environment from such an explosion is difficult to predict. Any plants, animals or humans in the immediate area would be subject to the effects of possible explosions and fires. However, the effects would be confined to the immediate area of the accident and would have only short-term effects.

5.2.5 SODIUM FLUORIDE

Sodium fluoride is used in the Contingency Dump Systems to remove UF6 from cascades in the event that both the product and tails take-off lines become unavailable (e.g., in the evnt of total loss of power). The sodium fluoride is transported to the facility in powder and pellet form.

If a release of sodium fluoride were to occur during transportation, a hazard would result from the aggressive characteristics of the fluoride ion. The powder would dissolve in water and cause damage to plants in the immediate area of the spill and to any animals or humans if ingested (Reference 4).

The effects of the spill would be confined to the immediate area of the spill. The dry powder would be shoveled up or removed with vacuum equipment. The material should be kept away from acids, and dissolved sodium fluoride would be diluted with surrounding water. The Environmental Protection Agency requires the reporting of a release of sodium fluoride in excess of 1000 pounds (Reference 3).

5.2.6 CITRIC ACID

Citric Acid is used in the facility to decontaminate equipment. It is shipped to the facility in granular form. If a spill of citric acid occurred during transport, the citric acid could hydrolyze with any surrounding water and considerably lower the pH of the water solution. If sufficient quantities were released it could cause damage to plants in the immediate area of the spill and to any animals or humans if ingested. The effects of the spill would be confined to the immediate area of the spill. The dry powder would be recovered from the spill site by shoveling or vacuuming. Any dissolved citric acid would be neutralized with sodium bicarbonate and diluted with surrounding water.

5.2.7 CHLOROFLUOROCARBONS

Chlorofluorocarbons (CFCs) are used as a refrigerant and as a heating and cooling medium in the operation of the enrichment process. They are also used as solvents for degreasing equipment. CFCs have been shown to deplete ozone in the upper portions of the atmosphere. If an accident were to occur while refrigerant was being transported to the facility, the refrigerant could be released to the environment adding to the cumulative burden of CFCs adversely affecting the ozone layer. It is anticipated that before operation of the facility, a suitable substitute for CFCs, such as hydrofluorocarbons (HCFCs), which greatly reduce the impact on stratospheric ozone concentration, will be commercially available and could be used at the facility (Reference 5).

REFERENCES FOR SECTION 5.2

1. Uranium Hexafluoride: Handling Procedures and Container Criteria. ORO-651-R5, USAEC, Oak Ridge, TN, September 1987.

2. An Assessment of the Risk of Transporting Uranium Hexafluoride by Truck and Train. EY-76-C-06-1830, Pacific Northwest Laboratory, Richland, Washington, August 1978.

3. 40 CFR Table 117.3, Reportable Quantities, 1988

4. Sax, N. Irving. Dangerous Properties of Industrial Materials. Sixth Edition. Cincinnati: Van Nostrand Reinhold Company, 1984.

5. Genesolv 2010 marketing literature. Allied Signal.

Table 5.2-1
<u>Health Effects of HF</u>

0.1 mg/m^3	perceptive odor concentration
2.5 mg/m^3	8-hr daily exposure ACGIH Threshold
25.0 mg/m^3	tolerable for several minutes with respiratory irritation
>40.0 mg/m^3	possibility of being fatal to humans at 1-hr exposure
100.0 mg/m^3	highest tolerable concentration for 1 minute with severe eye and respiratory irritation
245.0 mg/m^3	laboratory animal death from exposures for greater than 2 hours

Table 5.2-2

Assumed Limits and Effects of Uranyl Fluoride

< 2.5 mg inhaled	No effect
10.0 mg inhaled	Minimal health effects
20.0 mg inhaled	Clinical effects requiring two weeks medical care
100.0 mg inhaled	Assumed fatal

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6.0 EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAM

The purpose of this section is to describe in detail the means by which LES obtained its baseline data previously presented along with describing plans and programs for monitoring pertinent environmental parameters in order to evaluate the environmental impacts of facility operation and maintenance.

Section 6.1 addresses the measurement of "pre-existing" characteristics of the site and surrounding region. In this context, "pre-existing" refers to the preoperational state of the site. Section 6.2 deals with specific programs for monitoring environmental parameters which produce the data needed for reasonable estimates of the environmental impact caused by station operation.

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6.1 APPLICANT'S PREOPERATIONAL ENVIRONMENTAL PROGRAMS

The purpose of the pre-operational program was to identify the physical, chemical and biological variables which were likely to affect, or be affected by, the construction or operation of the CEC.

6.1.1 WATER

6.1.1.1 Onsite Lakes and Ponds

Physicochemical data were obtained from the centers of both Lake Avalyn and Bluegill Pond during two sampling rounds (January 20, 1990 and May 23, 1990). Dissolved oxygen concentrations were measured at 1-ft intervals using a Yellow Springs Instrument (YSI) polarographic oxygen probe and meter (Model 54). Conductivity and temperature also were obtained at 1-foot intervals with a YSI S-C-T meter (Model 33). Water samples for all other measurements were obtained from the surface only. Total alkalinity was determined by titration with a weak acid (Reference 1), pH was measured with an Orion portable pH meter, and turbidity with a Hach ratio turbidimeter. During the first sampling event, total hardness was measured with a Hach portable hardness kit. During the second sampling event a 25 cm Secchi Disk was used to determine water transparency, and surface and bottom samples were collected and analyzed for additional inorganic water chemistry parameters. The bottom samples were collected using an acid-washed polypropylene horizontal water sampler. With the exception of the samples which were to be analyzed for nutrient and mineral content, all of the water samples were treated with 5% acid solutions (either nitric or sulfuric acid) for preservation. The samples were subsequently analyzed using standard methods.

For the purpose of qualitative analysis, four sediment samples were collected from both Lake Avalyn and Bluegill Pond. These were obtained from evenly spaced locations down the centers of the ponds using a Ponar Sediment Sampler. Each sample was described and photographed.

Bathymetric surveys were performed on Lake Avalyn and Bluegill Pond in order to obtain volume estimates of these bodies of water. Prior to the surveys, aerial photographs were studied and significant bank features were identified. These features were used as guides in establishing transects at approximately 200- and 100-ft intervals across the width of Lake Avalyn and Bluegill Pond, respectively. These transects were run using a Lawrence Model X15 depth recorder device attached to a boat. In addition, one length-wise transect was run along the center of both Lake Avalyn and the Bluegill Pond. Volume estimates were made between adjacent transects by averaging the cross sectional areas of the transects and then multiplying that by their distance apart. The volume of the individual segments were then added to obtain a total volume estimate.

Measurements of specific conductance, temperature, dissolved oxygen, pH, alkalinity and water level will be made on a quarterly schedule of Lake Avalyn amd Bluegill Pond to document seasonal fluctuations prior to plant operation.

6.1.1.2 Streams

Two rounds of stream monitoring were performed on and in the vicinity of the site (May 23, 1990 and July 25, 1990). After measuring the total width of and depth at regularly spaced intervals across the streams, the equal-width increment (EWI) method was used to calculate the cross-sectional areas. Where sufficient flow existed, a Mead Flow Meter was used to obtain velocity measurements also following the guidelines of the EWI method. However, at a majority of the locations (all of the onsite locations) flow was insufficient to obtain reliable velocity measurements with the flow meter. In these instances a velocity estimate was obtained by timing the uninhibited movement of a small stick across a relatively uniform 3-ft section of the stream.

6.1.1.3 Groundwater

Shallow groudwater beneath the LES property was investigated by installing monitoring wells on the property between July 24 and 31, 1990 (reference Section 2.5.2.3.1 and Figure 2.5-11). The wells are 2 inch diameter and were drilled using a 6-1/4-in hollow stem auger (3-1/4-in auger for the deep well). Geologic logs for each of the wells were produced based on split-spoon samples collected at 5-ft intervals. In addition, undisturbed samples of the stratigraphic unit screened in each well were collected using 2-1/2-ft Shelby Tubes. These samples were analyzed for particle size distribution, bulk density, porosity, and total organic carbon using standard methods. When undisturbed samples could not be obtained using a Shelby Tube (as was the case for some of the particularly wet sands), a split-spoon sample was collected for particle size distribution and total organ carbon analysis.

After completion, most of the wells were air-developed. A compressor was used to force air down the well at approximately 140 psia until the turbidity of the water stabilized. The remaining wells (A-1, B-1, and B-2) were developed using a bladder pump. After development samples were collected from all of the wells. Prior to the collection of samples, three to five well volumes were purged using disposable polypropylene bailers and measurements of pH, temperature, and specific conductivity were taken. After these parameters stabilized, samples were collected for analyses using standard methods and Quality

Assurance procedures which meet US Environmental Protection Agency guidelines.

On August 13, 1990 slug tests were performed on each of the seven onsite wells. The tests were performed in order to obtain hydraulic conductivity estimates. The test involved the measurement of the initial water level in the well using an electronic water level indicator marked in hundredths of a foot. A slug of water was then evacuated from the well using a teflon bailer, and the water levels were measured at time intervals using the electronic water level indicator. These data (water level recovery vs. time) were analyzed using a BASIC program which statistically fits a line (by least squares) to the plotted points. Based on these plots and well configuration data, the hydraulic conductivity is calculated. While not precise, this method allows for an order of magnitude estimate to be made for hydraulic conductivity.

Both 2- and 3-dimensional contouring of shallow groundwater levels on site were performed using the Surfer graphics package. The average of the water levels measured August 1 and 13, 1990 were used for contouring, and the statistical inverse-distance method was applied to the data. This method was selected over the linear kriging approach because the highly variable geology and topography (and hence groundwater levels) are not expected to conform to a linear approximation. The extreme variability is most recognized between the central ridge on the property (wells A-1, E-1, and F-1) and the southwest drainage basin (well C-1).

Deep groundwater beneath the LES property was evaluated by means of the Theis equation (Reference 2) to evaluate the possible effects of anticipated water withdrawals from the Sparta Aquifer by the CEC (see Section 2.5.2.4). The Theis equation is applicable to confined aquifer conditions and is used for the prediction of drawdown at any distance from a pumping well for any time. The solution ignores recharge to the aquifer and, therefore, is considered to be conservative. Known aquifer transmissivity and storativity values and a range of pumping rates were used to estimate these drawdowns. In addition, the effects of withdrawals from the Central Claiborne Water System Well #4 were assessed individually and coupled with the withdrawals by the facility.

Prior to facility operations, measurement of water levels in all existing preoperational survey wells will continue on a quarterly schedule to document the seasonal range of groundwater fluctuations at the site.

6.1.2 AIR

No onsite monitoring of meteorological or air quality conditions at the CEC has been conducted; therefore, all data used in this report to characterize such conditions necessarily have been collected at offsite locations by independent agencies and institutions. The data were obtained through either literature searches or through direct contact with the agency or institution responsible for maintaining the data.

6.1.2.1 Meteorological Data

Meteorological conditions at the facility location were evaluated and summarized in Section 2.6.1 of this report in order to characterize the LES site climatology and provide a basis for predicting the dispersion of gaseous effluents. The primary source of these data was the National Oceanic and Atmospheric Agency (NOAA) Local Climatological Data (LCD) station located at the Shreveport Regional Airport approximately 56 mi. west-southwest of the site. Data collected at the Shreveport LCD station and used in the analysis include that for winds, precipitation, and temperature. Printed copies of these data were obtained directly from the NOAA (Reference 3). In general, average values reported in the NOAA data were based on a 30-year period of record (1951 to 1980), while extremes were based on a 36-year record ending in 1988.

A detailed justification for using the Shreveport data and a discussion of the extent it may be considered representative of the meteorology and climatology at the location of the facility are presented in Section 2.6.1. Part of this analysis involved comparing data from the Shreveport LCD station with data collected at other weather stations near the site. For example, temperature and precipitation data are collected at an observation station located approximately 6 mi. southwest of the site. The station is operated by the Louisiana State Agricultural Center which reports data on a monthly basis to the Shreveport LCD station. As with the Shreveport data, printed copies of the summary of the 1951 to 1980 Homer data were received directly from the NOAA (Reference 4).

Wind data are not collected at the Homer station. Wind data, however, are available from the Shreveport LCD station and two Federal Aviation Authority (FAA) weather stations at airports in Monroe, Louisiana and El Dorado, Arkansas, which are, respectively, about 60 mi. east-southeast and 40 mi. northeast of the site (see Figure 2.6-3). Printed copies of data were obtained from the NOAA which summarize joint frequencies of wind speeds and directions for a 9-year period (1950 to 1958) in Monroe and 5-year period (1949 to 1954) in El Dorado (Reference 4). These data were used to make a comparison of the means and extremes of wind speed at these two stations with the wind speed data from the Shreveport LCD station. Summaries of joint frequencies of wind speeds and directions at the Shreveport LCD station were obtained from the NOAA for a 5-year period (1984 to 1988). These data were used in the χ/Q dispersion analysis required for Sections 4.2.1.2 and 5.1 of this report. In addition to the 5-year joint frequency data, summary statistics for the Shreveport station (e.g., peak gusts, mean wind speed, and minimum and maximum monthly average wind speeds) were available from the NOAA for a 36-year period ending in 1988 (Reference 3).

The effect of the difference in winds between the site location and the Shreveport LCD station on the χ/Q analysis was assessed in Section 2.6.1.3 via an air dispersion modeling exercise. The analysis, as described in that section, essentially consisted of comparing the output from a computer air dispersion model using the 1984 to 1988 Shreveport meteorological data with the output obtained using a composite meteorological data set based on meteorological data from the Shreveport station and the two FAA stations in Monroe and El Dorado. The source of the composite data was the Personal Computer Graphical Exposure Modeling System (PCGEMS), which has been developed by the EPA as a database and modeling system for the performance of exposure assessment studies (Reference 5). The meteorological data contained in PCGEMS for the Shreveport, Monroe and El Dorado Stations are based on 5-year records (i.e., 1970 to 1974, 1954 to 1958 and 1950 to 1954, respectively).

A discussion of storms and other forms of severe weather as they have occurred in Northern Louisiana is presented in Section 2.6.1.4. The information and data reported in this section were obtained primarily from the Tornado and Straight Wind Speed Study for the Proposed Uranium Enrichment Plant Site prepared for Fluor Daniel, Inc. by McDonald-Mehta Engineers (Reference 6). Additional information was obtained from Violent Tornado Climatography (Reference 7), the NOAA annual summary of data from the Shreveport LCD station (Reference 3), and a letter from the Claiborne Parish Civil Defense (Reference 8), which describes a tornado sighting in 1986.

6.1.2.2 Air Quality Data

Only air quality data for existing levels of Clean Air Act Criteria Pollutants are available for Northern Louisiana. These data were presented and compared to the National Ambient Air Quality Standards (NAAQS) in Section 2.6.2 of this report. The primary source of the data was the Louisiana Division of Air Quality (LDAQ), which supplied printed copies of the data from their database. Data were obtained from a total of four LDAQ stations in Northern Louisiana. The stations are:

a. the Keel Radio Station in Dixie, a small town about 15 mi. north of Shreveport,

b. the Claiborne Public Health Unit in Homer,

c. the Shreveport Downtown Airport, and

d. the airport in Monroe.

Based on availability and relevance to the site, TSP data from Homer and Dixie, sulfur dioxide data from Shreveport and Monroe, and ozone data from Dixie, Shreveport, and Monroe are presented and discussed in Section 2.6.2. All of these data were from a 5-year record (1984 to 1988), with the exception of ozone, which was examined for the entire available record of 8 years (1981 to 1988) for reasons noted in Section 2.6.1. For two criteria pollutants, not measured at any of the above LDAQ sites, the EPA's 1985 Annual Statistics on Air Quality (Reference 9) reports on measurements conducted in Shreveport and Monroe. The minimum, median, and maximum lead levels in 1985 in Shreveport and the mean and maximum nitrogen dioxide levels in 1985 in Monroe and Shreveport are identified in Section 2.6.2 as reported in this reference.

A general examination of the potential for air pollution in the region near the facility is presented in Section 4.2.2.6. This examination is based on seasonal and annual mixing height and wind speed data presented by Holzworth (Reference 10) explicitly for this purpose.

6.1.3 LAND

6.1.3.1 Geology and Soils

Geological and soils studies have been performed at the site to determine the nature of surface and subsurface conditions. A description of sample collection sites and the methodologies utilized to evaluate soil and rock materials is presented in Section 3.6 of the Safety Analysis Report. Geology and soils studies at the site have included: test borings, test pits, insitu permability tests, refraction profiling, static and dynamic laboratory tests, and analysis of bearing capacity and settlement. The principle objective in conducting geology and soils studies was to evaluate the structural integrity of the site for engineering purposes and to characterize certain physico-chemical aspects related to surficial groundwaters.

6.1.3.2 Land Use and Demographic Surveys

An inspection of the 5-mi. radius surrounding the site was conducted to locate households and any historic, scenic, cultural, or natural landmarks. Land use patterns for this area were also identified. This information was plotted and evaluated by radial sector as discussed in Section 2.2 of this document.

To estimate projected populations of the 5-mi. radius surrounding the site, Mr. Vincent Maruggi, with the Division of Business and Economic Research of the University of New Orleans, was first contacted to obtain the estimated population of Claiborne Parish for 1988. This estimated population was compared with 1990 population estimates for Claiborne Parish, also furnished by Mr. Vincent Maruggi, to determine projected growth of the area within a 5-mi. radius of the site. Demographic information also was obtained for Claiborne Parish from the Woods and Poole Economic Database. Demographic information from this database can be requested from Woods & Poole Economics, Inc., Washington, D.C. Projected populations for Claiborne Parish were reported by Mr. Maruggi through the year 2000. To determine projected populations through the year 2035, it was assumed that the percentage of the population contributed from a single radial sector remained constant with time.

6.1.4 BIOTA

Preoperational monitoring programs were conducted at the site. The initial monitoring was designed to characterize the ecological community as it existed at the site prior to and after extensive clearcutting had occurred (see Section 2.7). This consisted of field surveys of the plant, avian, and aquatic communities at the site and qualitative analyses of the likely composition and distribution of the site's mammalian, reptile, and amphibian communities. The latter analyses were based on knowledge of existing habitat at the site and of species-specific distribution and habitat preferences. These analyses were supplemented by information provided by personnel from the Louisiana Department of Wildlife and Fisheries (References 12, 13, 14), the Louisiana Natural Heritage Program (Reference 15), the Louisiana Department of Forestry (Reference 16), and the U.S. Fish and Wildlife Service (Reference 17). Additional information was obtained from field guides (References 18, 19), and other summary sources (References 20, 21, 22) and from an inventory of Louisiana wildlife (Reference 23). This information is summarized in Section 2.7.

As discussed in Section 2.7, clearcutting at the CEC site has resulted in an alteration of the ecological community of the site. For example, the successional stages of several of the forest communities at the site have been altered significantly, moving towards earlier stages of succession. Such changes in the plant communities also result in changes in the associated wildlife community. However, over time, the plant and wildlife communities will continue to change as natural successional processes result in a movement of the communities toward pretimbering conditions. Because of this continual change, the baseline plant and animal communities used to evaluate potential impacts of the facility will be changing constantly. When site operational monitoring programs are instituted in accordance with compliance permit requirements, the extent of the ecological changes that have occurred since the baseline studies will be documented.

The procedures and methodologies for preoperational monitoring are described below for each of the communities.

6.1.4.1 Preoperational Programs--Vegetation

A botanical assessment was conducted on June 16, 17, and 23, 1990. The purpose of the study was to develop a general vegetative map of the property. Further, because large-scale timbering had occurred recently at the site, the successional trends for each vegetative community were noted.

To conduct the botanical survey, the entire site was first flagged each 0.1 mi. This survey divided the property into 100 increments, each 0.01 mi^2. Then, a visual ground survey of the vegetation was conducted and the dominant vegetative community for each square was recorded on a map. Five distinct terrestrial plant communities were identified. These are:

a. upland mixed forest--recent harvest,
b. upland mixed forest--several years since harvest,
c. upland forest--pine dominated,
d. upland mixed forest--mature, and
e. bottomland hardwood forest

The plant species that occurred in each survey area were identified, and their relative abundance within the surveyed unit was estimated. The following qualitative terms were used to describe the relative abundance of plant species on the site.

Dominant: the most prevalent species within a given vegetative community based on considerations of biomass (qualitatively determined by number and size of individuals). A community may have one or more dominant species or no dominant species.

Common: a species that may be noted at any random point within a specific vegetative community.

Moderate: a species that may or may not be noted at any random point but that may be located with a limited amount of searching.

Scattered: a species that occurs only a few times within a given vegetative community or a species that is abundant in only one or two localized areas.

Macrophytic vegetation in and around Lake Avalyn and Bluegill Pond was surveyed. Survey grids were not established for the pond vegetative survey, but rather the plant species that occurred in three distinct areas along the perimeter of the Lake and pond were recorded. The areas surveyed were as follows:

a. In the water:
this included free-floating species and species rooted within the mud and emergent above the surface of the water.

b. Immediate bank:
this included species that occupied a strip usually only a few feet wide which is generally inundated during periods of heavy rain and runoff.

c. Upper bank:
this included species that occupied a strip extending from the immediate bank to the top of the bank.

The relative abundance categories that were used for terrestrial plant communities also were used to describe abundance for the macrophyte community associated with the lake and pond.

The results of the botanical survey are summarized in Section 2.7.1 for terrestrial plant communities and in Section 2.7.3 for aquatic plant communities.

6.1.4.2 Preoperational Program--Birds

Site-specific avian surveys were conducted by Goertz in January (three days) and April (one day) 1990 to verify the presence of particular bird species at the site. The January survey was conducted before the clearcutting occurred in the spring and early summer of 1990. The winter and spring survey was designed to characterize in general terms the members of the avian community.

For the winter survey, the distinct habitats at the site were first characterized (see Table 6.1-1) and then the bird species composition within each of these habitats was noted. Transects 100 m in length were established within each distinct homogenous habitat, and data were collected at every 5 m transect interval. Species composition and relative abundance were determined based on visual observations, call counts, and nest identification.

In addition to verifying species presence, the spring survey was designed to determine the nesting and migratory status of the species observed and (as a measure of the nesting potential of the site) to determine the occurrence and number of territories of singing males and/or exposed, visible posturing males. The area was censused for breeding birds by spot mapping using the procedures described by the International Bird Census Committee (Reference 24). Spot mapping is a common technique for censusing passerine breeding birds (Reference 25). Censusing was conducted in the three major habitats of the area listed in Table 6.1-1.

The results of the avian survey are summarized in Section 2.7.2.

6.1.4.3 Preoperational Programs--Mammals

No on-site surveys have been conducted to characterize the preoperational mammalian communities of the site. The mammals likely to be present were inferred from knowledge of existing habitat and of species-specific distribution and habitat preferences. Literature sources and State and Federal wildlife officials were contacted for information to support the analysis (see Section 6.1.4).

The mammalian communities are described in Section 2.7.2.

6.1.4.4 Preoperational Programs--Reptiles and Amphibians

As was the case with mammals, no onsite surveys were conducted to characterize the preoperational reptile and amphibian communities of the site. The species likely to be present were inferred from knowledge of existing habitat and of species-specific distribution and habitat preferences. Literature sources and State and Federal wildlife officials were contacted for information to support the analysis (see Section 6.1.4).

The reptile and amphibian communities are described in Section 2.7.2.

6.1.4.5 Preoperational Programs--Aquatics

An aquatic survey was conducted in Lake Avalyn and Bluegill Pond on January 20, 1990. The waters were surveyed for plankton (phytoplankton and zooplankton), benthic organisms, and fish.

Plankton were surveyed by collecting a 100 L sample of water from the center of the lake and the pond. Samples were dipped with a calibrated, wide-mouth plastic pail and poured through a Wisconsin straining net (80 µm mesh), concentrated into glass-stoppered graduated cylinders, fixed with Lugol's solution and transferred into 4-oz. wide-mouth bottles.

Zooplankton were identified only as miscellaneous Protozoa, Rotataria or Copepoda (adult or nauplius). Specimens were identified and enumerated in a Sedgewick-Rafter counting cell following the method of Lind (Reference 26) using a combination of slide counts and strip counts at 100X magnification. Data were reported as number of organisms/L of lake water.

Phytoplankton were identified and enumerated using a Palmer counting cell at 400X magnification. In some cases all of the 0.05 ml counting cell was observed and in other cases 50 random fields were observed. Organisms were identified as dinoflagellates, filamentous green algae, single cell green algae, yellow-green algae, desmids, and diatoms. Data were recorded as the number of cells/L of lake water. Classification followed that of Prescott (Reference 27).

Benthic samples for quantitative analysis were collected from four locations in the pond and the lake using a Ponar dredge. The four benthic samples from each water body were taken by starting near the shoreline and progressively moving into deeper water (sampling depths were 1-1/2 ft., 4 ft., 8 ft., and 12 ft. to 14 ft respectively). Shoreline samples were collected from areas with beds of rooted vegetation in an attempt to maximize the number of habitat types in order to obtain a more representative sample of the actual benthic diversity as a reflection of water quality and not a function of substrate conditions only. In addition, a random sample to be used in qualitative analysis was collected from the lake and the pond using a D-frame aquatic sweep net. The random sweep net sample was collected to supplement the dredge sample by capturing organisms capable of escaping capture by the Ponar dredge and those that would not normally be captured by the dredge due to particular habitat preferences.

All benthic samples were sieved through a #30 field screen, placed in liter bottles, preserved with 10% formalin in the field, stained with Biebrich Scarlet and Eosin B, and hand picked under illuminated magnification. Specimens from the quantitative samples were identified to the family level with exception of annelid worms, which were identified to the Class level (Oligochaeta). Specimens from qualitative samples were identified in a like manner but were not counted because only their presence was considered as important to the study. Nomenclature of the benthos followed Ward and Whipple (Reference 28).

Fish were collected using a 6 mm mesh net, 8 ft. by 20 ft. in size, along the shoreline up to a depth of approximately 4 ft. The lake and pond were sampled for approximately 30 min. each. Representative fish were preserved in a 10% formalin solution for later reference or voucher. Nomenclature for the fish and identification characteristics followed Douglas (Reference 29).

The results of the aquatic survey are summarized in Section 2.7.3.

6.1.5 PREOPERATIONAL RADIOLOGICAL MONITORING

6.1.5.1 Summary of Baseline Radiological Data

Samples were taken at the facility site in order to assess its pre-existing radiological conditions. The types, numbers, and locations of the samples taken are presented in Table 6.1-2 along with a brief synopsis of the radionuclides and activities found. The data presented here is not intended to be a substitute for a sound preoperational monitoring program, but to briefly characterize the site conditions prior to construction.

6.1.5.2 Overview of the Preoperational Radiological Monitoring Program

Regulatory Guide 4.9 (Reference 1), "Preparation of Environmental Reports for Commercial Uranium Enrichment Facilities" was used as the primary reference for the development and implementation of the licensing [illegible] of the project. In accordance with the requirements of Reference 1, the preoperational radiological monitoring program is described with the appropriate detail in the following text. The preoperational program will focus on collecting needed data to perform critical pathway analyses, including selection of nuclide/media combinations to be encompassed into the operational surveillance program. Identification of radionuclides will be performed using accurate and sensitive analytical equipment, as is technically appropriate. Data collection during this period will be planned to provide an adequate statistical base for evaluating any future changes in environmental conditions, which might be caused by facility operation. This is essential for proper assessment of doses due to facility operation after onset of enrichment.

The preoperational program will be more extensive than the operational program in order to provide this base of knowledge and also to anticipate changing conditions around the site as the facility is built and operated. Environmental surveillance at the Louisiana Energy Services Uranium Enrichment Facility is a major part of the radiological program in order to provide data for scientific studies, to provide supplementary checks of containment and effluent controls, to assess radiological impacts on site environs, to estimate potential impact on members of the public, and to determine compliance with applicable radiation protection standards and guidelines. Surveillance will be initiated prior to the operation of the facility in order to provide preoperational (baseline) data and to adequately define the extent of site-specific terrestrial radioactivity.

6.1.5.3 Proposed Preoperational Radiological Monitoring Program

The Preoperational Radiological Monitoring Program will be initiated at least one year prior to the operation of the enrichment facility to provide a sufficient database for comparison with the Operational Radiological Monitoring Program, and to provide experience that will improve the efficiency and quality of the Operational Radiological Monitoring Program.

Table 6.1-3 describes the Preoperational Radiological Monitoring Program. Table 6.1-4 lists the detection capabilities for environmental sample analysis. Table 6.1-5 lists the reporting levels for environmental sample analysis that will be assessed during the preoperational program. If the values listed in Tables 6.1-4 and 6.1-5 are not appropriate, then changes will be initiated and documented. Such changes can be initiated and documented during the preoperational program or during the operational program.

Sections 6.1.5.3.1 through 6.1.5.3.3 describe the rationale behind the sample types chosen. The rationale presented is based on the data available at the time of this report. The rationale is subject to change as additional knowledge is discovered which would allow for improved and more efficient environmental monitoring, at a reasonable cost, so that the environment surrounding the facility is maintained in a safe and acceptable manner. During the implementation of the preoperational program, some samples may be unavailable or may be collected differently than specified. Under these circumstances, documentation shall be created to describe the rationale and actions behind the decisions. If a sampling location has frequent unavailable sample or deviations from the schedule, then another location should be selected as its replacement or other appropriate actions should be taken.

6.1.5.3.1 Atmospheric Radioactivity Monitoring

The air monitoring program will use the meteorological data from the Shreveport Meteorological Station from 1984 through 1988 (more recent meteorological data may be used as it becomes available). Plant design data, geographical data, Chi/Q values, D/Q values, land use data, radioactive inventory data, and radioactive effluent data that may be released from the facility will be used to determine the most appropriate method for determining the deposition of airborne radioactivity to the environment around the facility as a result of operation. Deposition and inhalation parameters can then be used to determine the effective committed dose equivalent attributed to facility operation.

The primary radioactive material that may be released is uranium, which has a short term for dispersal to the environment. The majority of the air monitoring sites are in the prevailing wind direction, based on historical data of frequency of wind speed and direction, and located within 1.0 mile of the facility. The sampling filters will entrain radioactive particles that may be deposited in the environment. The fraction of particles caught by the filter will depend upon meteorological conditions that exist during the sampling period.

One air monitoring site will be located in the least predominant wind direction greater than two miles from the plant site. This information will be useful in evaluating background fluctuations during the operation of the facility.

6.1.5.3.2 Hydrospheric Radioactivity Monitoring

Trace amounts of radioactive materials may be contained on the site within Bluegill Pond. Additionally, the Hold-Up Basin may contain small amounts of radioactivity from roof drains and other releases. In order to assess the amount of radioactivity released into the liquid pathway, surface water will be sampled from Bluegill Pond and the Hold-Up Basin on the site.

Ground water sampling will be based on available hydrology data. Although uranium has very low transport properties in soils, sampling will be performed in order to assure protection of ground water aquifers and to document changes, if any, in natural background characteristics. Ground water will be sampled from at least one well on the site and at one residence or business (if available) less than two miles from the facility in a location where ground water could be potentially affected by operation of the facility.

6.1.5.3.3 Geospheric Radioactivity Monitoring

Soil sampling will be performed in the same prevailing wind directions (geographical sectors) as the air monitoring site locations and in areas that may be impacted by effluents. The areas impacted by effluents will be identified, as appropriate, as the program progresses and the operating characteristics of the facility are documented. This sampling will determine the amount of any trace amounts of radioactive material that may be deposited to the ground from plumes or other effluent streams from the facility that may contain radioactive material.

REFERENCES FOR SECTION 6.1

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Table 6.1-1

MAJOR AND MINOR HABITAT AT THE LES SITE
AS DETERMINED DURING ONSITE AVIAN SURVEYS

MAJOR HABITATS	DESCRIPTION
Old-cutover	Areas cut between 5 and 10 years ago. Pine and sweetgum prevalent.
Select-cut pine	Areas that have been selectively timbered to remove mature pine. Pine and sweetgum prevalent.
Clear-cut	Areas that have been clear cut within the last two years. Dominated by shrub and herbaceous vegetation.
Hardwood bottom	Undisturbed areas along streams, pond, and lake. Beech, oak, gum, maple, hickory prevalent.
MINOR HABITATS	
Lake Avalyn shoreline	Wet areas. Buttonbush, alder, willow prevalent.
Lake Avalyn dam base	Swampy area in the vicinity of the lake overflow pipe. Herbaceous wetland species prevalent.
Bluegill Pond edge	Hardwood bottom vegetation along pond.
Log and slash piles	Scattered. Left from previous logging operations.
Fence row	Each side of Parish Road 806.
Lake Avalyn campground	Dominated by mature pines.

TABLE 6.1-2

SUMMARY OF PRE-EXISTING RADIOLOGICAL CONDITIONS AT THE CLAIBORNE ENRICHMENT CENTER

Sample Type Collected	# Samples Collected	Nuclide Identified	Activity Range	Activity Mean
Airborne Radioiodines	4	none (a)	(b)	(b)
Airborne Particulates	4	none (a)	(b)	(b)
Broad Leaf Vegetation	12	Cs-137 (a)	(c)	115 pCi/kg
Surface Water	21	none (a)	(b)	(b)
Ground Water	15	none (a)	(b)	(b)
Sediment pCi/kg	16	Cs-137 (a,d)	64-4534	1044
Soil pCi/kg	38	Cs-137 (a,e)	133-1123	698

Footnotes to Table 6.1-2:

(a) Gamma spectroscopy analysis only.

(b) No nuclides identified, therefore no activity ranges or means exist.

(c) No range exists because only one sample was determined to have activity.

(d) Positive identification of Cs-137 was made in 16 of 16 samples.

(e) Positive identification of Cs-137 was made in 24 of 38 samples.

TABLE 6.1-3

PREOPERATIONAL RADIOLOGICAL MONITORING PROGRAM

Pathway/ Sample Type (a)	Number of Representative Samples and Locations	Sampling and Collections (f,g,h)
Airborne Particulate (b)	One sample (AP1) located in the sector in the highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP2) located in the sector with the second highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP3) located in the sector with the third highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP4) located in the sector with the fourth highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP5) located in the sector with the least prevailing wind direction. Sampler to be located off facility grounds.	Air sampler with a particulate filter, operating continuously and collected weekly
Airborne/ Soil (d)	Five samples (S1-S5) to be collected near the air sampling sites.	Collected semi-monthly

TABLE 6.1-3

PREOPERATIONAL RADIOLOGICAL MONITORING PROGRAM - continued

Pathway/ Sample Type (a)	Number of Representative Samples and Locations	Sampling and Collections (f,g,h)
Airborne/ Vegetation (d)	Five samples (BLV1-BLV5) to be collected near the air sampling sites.	Collected monthly
Liquid/ Ground Water (c)	Two samples (GW1, GW2) to be collected from onsite wells. One sample (GW3) to be collected from an offsite well, if available.	Grab samples collected monthly
Liquid/ Surface Water (c)	One sample (SW1) to be obtained from Bluegill Pond where receiving waters from the facility are anticipated to enter the Pond. One sample (SW2) to be obtained from Bluegill Pond at the end nearest the outflow. One sample (SW3) to be obtained from the Hold-Up Basin outflow. One sample (SW4) to be obtained from a location not impacted by facility operation.	Grab samples collected monthly
Liquid/ Bottom Sediment (e)	Two samples (BS1, BS2) to be taken from the bottom of Bluegill Pond near the surface water sites.	Collected quarterly

TABLE 6.1-3

PREOPERATIONAL RADIOLOGICAL MONITORING PROGRAM - footnotes

(a) The number, media, frequency, and location of samples may vary from site to site. This table presents an acceptable minimum program for a site at which each entry is applicable. The code letters in parenthesis (i.e. AP1, SW2) provide one way of defining generic sample locations and can be used to identify the specific locations during the exact designation of each sample site.

(b) Air particulate samples will be collected on filters attached to continuously operating air samplers.

(c) Water samples will be collected using water collection buckets, bottles, pumps, etc. and stored in clean containers.

(d) Soil samples will be collected using scoops, shovels, etc. as appropriate. Representative vegetation samples will be obtained as they are available.

(e) Bottom sediments will be collected using a device that will gather the top surface of the sediment, not to reasonably exceed a depth of six to eight inches. The sampling locations should be selected in conjunction with anticipated concentrations of facility-related radionuclides or in conjunction with the surface water sites.

(f) Sufficient volumes of samples will be collected when available, using accurate sample collection methods to ensure the attainment of Lower Limits of Detection as specified in Table 6.1-4.

(g) Samples collected will be sent to an appropriate laboratory for analysis via a reliable shipping organization. A sample transmittal form will accompany the samples. Samples will be packaged in a manner to ensure the integrity of each during transit.

(h) Gamma and alpha spectroscopy will be performed on all samples collected. Some sediment, soil, and air samples may not provide valid alpha spectroscopy data in which case gross alpha measurements will be performed. Alpha spectroscopy can be performed via chemical or radiological techniques, depending on current technology.

NOTE: The number, media, frequency, and location of samples may be modified to reflect the facility's operating history and other information.

TABLE 6.1-4

LOWER LIMITS OF DETECTION (LLD) FOR ENVIRONMENTAL ANALYSES

NUCLIDE	WATER (pCi/liter)	OIL/SEDIMENT Ci/kg/dry)	AIR (pCi/m3)
GROSS ALPHA (a)	4	(b)	0.01
U-238	1	1	0.05
Th-234	1	1	0.05
U-234	1	1	0.05
Cs-134 (c)	15	150	0.05
Cs-137 (c)	18	180	0.06

(a) Gross alpha analysis may be performed on samples when the alpha spectroscopy has indicated that too many natural nuclides are present to accurately quantify specific nuclides.

(b) Not applicable for this sample type.

(c) Cesium LLD's are listed to provide for adequate sensitivities during gamma spectroscopy.

TABLE 6.1-5

REPORTING LEVELS FOR ENVIRONMENTAL ANALYSES

NUCLIDE (a)	WATER (pCi/liter)	SOIL/SEDIMENT (pCi/kg/dry)	AIR (pCi/m3)
U-238 (b,c)	10	(d)	0.5
U-235 (b,c)	10	(d)	0.5

(a) Reporting levels are not applicable for nuclides that are not listed.

(b) Activity above background levels.

(c) Water and air reporting levels based upon ten times the LLD value from Table 4.2-4

(d) Reporting level not applicable for this sample type.

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6.2 OPERATIONAL MONITORING

The baseline studies discussed in Section 6.1 provide initial data necessary to determine the physical, chemical, and biological variables which are likely to be affected by CEC construction and operation.

The proposed monitoring program for CEC operation is outlined in this section.

6.2.1 OPERATIONAL RADIOLOGICAL MONITORING PROGRAM

6.2.1.1 Effluent Monitoring Systems

Comparisons of effluent data to environmental data will be performed as determined by release data. Under routine operating conditions, no significant activity should be released from the facility and this should be confirmed by environmental data. If an accidental release of uranium should occur, then the environmental data can be used to help assess the extent of the release.

6.2.1.2 Proposed Operational Environmental Monitoring Program

The Preoperational Radiological Monitoring Program will be superseded by the Operational Radiological Monitoring Program (outlined in Table 6.2-1) at the time the facility receives its first shipment of uranium hexafluoride.

The rationale for the operational radiological monitoring program is similar to the preoperational monitoring program (see Sections 6.1.5.3.1 through 6.1.5.3.3). The frequency of some types of samples will be reduced as compared to the preoperational program since the goal of establishing a significant baseline will have been accomplished. Adjustment of the LLD's and reporting levels listed in Tables 6.1-4 and 6.1-5, respectively, may be done based upon data obtained and reviewed during the preoperational program. The operational sampling program may be adjusted as it is implemented so that monitoring data will be reliable without incurring unnecessary work.

As construction work at the uranium enrichment plant proceeds, changing conditions (e.g., regulatory, site characteristics - both radiological and non-radiological, technology, etc.) and new knowledge may require that the operational monitoring program be reviewed and updated. Such review could be performed when environmental data indicate a positive significant trend with respect to radionuclide activities. Minute increases and/or decreases in activity are indicative of background fluctuations and would not initiate an investigation. During the implementation of the operational program, some samples may be unavailable or may be collected differently than specified. Under these circumstances, documentation shall be created to describe what was done and the rationale behind the decisions. If a sampling location has frequent unavailable samples or deviations from the schedule, then another location can be selected or other appropriate actions taken.

Each year, LES submits a summary of the environmental sampling program and the associated data to the proper regulatory authorities. This summary includes the types, numbers, and frequencies of samples collected and the identities and activities of nuclides found in the samples that can be reasonably attributed to facility operation.

6.2.2 PHYSICAL AND CHEMICAL MONITORING

6.2.2.1 Effluent Monitoring System

Specific information regarding the source and characteristics of all non-radiological plant wastes that will be collected and disposed of offsite, or discharged in various effluent streams is provided in Section 7.2 of the Safety Analysis Report (SAR). Chemical constituent quantities which will be discharged to the natural environment in facility effluents will be below concentrations which have been established by State and Federal regulatory agencies as protective of human health and the natural environment.

6.2.2.1.1 Surface Water Monitoring Program

Surface water samples have been collected at several locations within and outside the plant site and analyzed to establish site "baseline" water quality conditions. Baseline sample collection locations and tabulated physiochemical data are presented in Section 2.5.

Prior to initiation of facility operation, and continuing on a quarterly basis thereafter throughout the life of the plant, additional water samples will be collected, analyzed and compared to the baseline data to monitor any impact the facility operations might have on surface water quality. Locations where surface water samples will be collected on a quarterly basis during facility operation are shown in Figure 6.2-1. A list of the physiochemcial parameters which will be analyzed along with the analytical methodologies for each is presented in Table 6.2-2.

6.2.2.1.2 Groundwater Monitoring Program

Chemical measurements of the shallow onsite groundwaters and the deep sparta aquifer zone underlying the site have been made to establish "baseline" groundwater quality conditions of the facility site. Collection locations and tabulations of this baseline information are presented in Section 2.5.

Prior to facility operation and continuing on a quarterly basis thereafter throughout the life of the plant; additional groundwater samples will be collected, analyzed and compared to the baseline data to monitor any impact facility operations might have on groundwater quality. Locations where groundwater samples will be collected on a quarterly basis during operation are shown in Figure 6.2-2. A list of parameters which will be analyzed in groundwater samples plus the analytical methodologies for each is presented in Table 6.2-3.

6.2.2.2 Environmental Monitoring

The purpose of this Section is to describe the operational surveillance monitoring program which will be employed by the Claiborne Enrichment Center (CEC) to measure non-radiological chemical impacts upon the natural environment.

The ability of both regulatory agencies and CEC operational personnel to detect as well as correct any potentially adverse chemical releases from the facility to the environment will rely on chemistry data which will be collected as part of the monitoring programs described in the preceding Section 6.2.2.1. Data acquisition from these programs encompasses both on and off-site sample collection locations and chemical element/compound analyses commonly mandated by Federal and State National Pollution Discharge Elimination System (NPDES) compliance programs.

The range of chemical surveillance and analytical sensitivity incorporated into all the planned effluent monitoring programs for the facility should be sufficient to predict any relevant chemical interactions in the environment related to plant operations. In addition, to insure the facilities operation will have no environmental impact, the CEC intends to limit chemicals in all facility effluents to levels below those prescribed by State of Louisiana and the USEPA, as being protective of human health and the natural environment.

6.2.3 METEOROLOGICAL MONITORING

This Section provides details of the program designed to monitor meteorological phenomena during plant operation, in accordance with the specifications listed in Regulatory Guide 1.23 for onsite meteorological programs (Reference 1). This monitoring network will be adequate to evaluate the atmospheric dispersion at the site for both normal and accident conditions.

The terrain in and around the facility is relatively flat which makes it possible to obtain characteristic meteorological information for the entire site from a single instrument tower. Based on site inspections and facility plot plans, the tower location which provides the most accurate and representative measurements of required meteorological data is to the south of the plant (see Figure 6.2-3). This location was selected so that the tower would be far enough from facility stuctures to minimize their impacts on the wind distribution. In addition, the meteorological characterization for the site area presented in Section 2.6 indicates that the wind blows predominantly from the south, therefore, the building structures will have no significant impact on the predominant winds. The tower base will be located at approximately the same elevation as the finish grade for the facility structures.

All instruments selected for use in the meteorological monitoring program will meet or exceed the performance specifications outlined in Regulatory Guide 1.23 (Reference 1). The instruments listed in the following discussion may be replaced by other models, but the replacements will have equal or better performance specifications.

Wind speed will be measured using the Met One 014A Wind Speed Sensor. This instrument records wind speeds in the 0 to 100 mph range with a starting threshold of 1 mph. It is accurate to ±0.25 mph or 1.5% and has a standard distance constant of less than 15 ft. and an optional fast response distance constant of less than 5 ft. Wind direction will be measured using the Met One 024A Wind Direction Sensor. This 3-cup anemometer has a starting threshold of 1 mph and an accuracy of ±0.5 mph. Both sensors will operate in temperatures from -50 C to +70 C.

Onsite temperature will be monitored using the Met One 060A Ambient Temperature Sensor (Dash No -2). Temperature difference (which will be used to estimate atmospheric stability) will be measured using the Met One 062A Air Temperature Difference Sensor. Both sensors operate in the ambient range of -50 C to +50 C to an accuracy of 0.1 C. There is no self heating of the sensors and the time constant is 10 sec. in still air. Both the air temperature sensor and the air temperature difference sensor will be shielded from solar radiation effects using the Met One 076B model radiation shield. This shield operates in temperatures ranging from -50 C to +85 C. Radiation error is less than 0.05 F under a maximum solar radiation of 1.6 gm-cal/cm^2/min.

The monitoring instruments listed above will be connected to the Met One 451L data recorder via a Met One model 104 translator for signal conditioning. The 451L model is an intelligent datalogger designed for environmental monitoring. Data are sampled once every 10 sec., and averages are built upon the individual samples. Built-in firmware provides for vector/scalar averaging, which is then recorded on a removable magnetic cartridge. The datalogger output also will be directed to digital display units, which will provide real-time displays of ambient temperature, wind speed, and direction. In addition, analog recorders will also be used for temperature difference and wind speed and direction as backup to the digital equipment.

The monitored data will be transferred from the magnetic cartridge to a computer for data manipulation. Hourly averages of wind speed, direction, ambient temperature, and temperature difference will be compiled and then used to produce joint frequency distributions of wind speed and direction as a function of atmospheric stability on a monthly basis. The monthly data will be used to construct an annual joint frequency distribution at the end of each calendar year.

The accuracy of the meteorological monitoring program will be insured through the use of scheduled instrument calibrations and servicing. Instrument calibrations will be accomplished at least semiannually using precision internal reference sources. The servicing schedule will be in accordance with the manufacturers recommendations, or as needed for unscheduled maintenance due to equipment failure. The program for instrument maintenance and servicing combined with the redundant data recorders will assure at least a 90% data recovery.

6.2.4 BIOTA

The procedures used to characterize the plant, bird, aquatic, mammalian, and amphibian/reptilian communities of the proposed site during preoperational monitoring are regarded as appropriate for the operational monitoring program. Operational monitoring surveys also will be conducted quarterly (except annually for amphibians/reptiles) using the same sampling sites established during the preoperational monitoring program.

These surveys should be sufficient to characterize gross changes in the composition of the vegetation or avian, aquatic, mammalian, and amphibian/reptilian communities of the site associated with operation of the facility plant. Interpretation of operational monitoring results, however, must consider those changes that would be expected at the proposed site as a result of natural successional processes. Plant communities at the site, particularly those that were clearcut in 1990, will continue to change as forests regenerate and begin to mature. Changes in the bird community are likely to occur concomitantly in response to the changing habitat.

REFERENCES (6.2)

1. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.23, On-site Meteorological Programs (Safety Guide 23), February 1972.

TABLE 6.2-1
SUMMARY OF ENVIRONMENTAL RADIOLOGICAL MONITORING
SAMPLING SITES - OPERATIONAL PROGRAM

Pathway/ Sample Type (a)	Number of Representative Samples and Locations	Sampling and Collections (f,g,h)
Airborne Particulate (b)	One sample (AP1) located in the sector in the highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP2) located in the sector with the second highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP3) located in the sector with the third highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP4) located in the sector with the fourth highest prevailing wind direction. Sampler to be located within the site boundary. One sample (AP5) located in the sector with the least prevailing wind direction. Sampler to be located off facility grounds.	Air sampler with a particulate filter, operating continuously and collected weekly
Airborne/ Soil (d)	Four samples (S1-S4) to be collected near the air sampling sites.	Collected quarterly

TABLE 6.2-1
SUMMARY OF ENVIRONMENTAL RADIOLOGICAL MONITORING
SAMPLING SITES - OPERATIONAL PROGRAM - continued

Pathway/ Sample Type (a)	Number of Representative Samples and Locations	Sampling and Collections (f,g,h)
Liquid/ Ground Water (c)	Two samples (GW1, GW2) to be collected from onsite wells. One sample (GW3) to be collected from an offsite well, if available.	Grab samples collected quarterly
Liquid/ Surface Water (c)	One sample (SW1) to be obtained from Bluegill Pond where receiving waters from the facility are anticipated to enter the Pond. One sample (SW2) to be obtained from Bluegill Pond at the end nearest the outflow. One sample (SW3) to be obtained from the Hold-Up Basin outflow. One sample (SW4) to be obtained from a location not impacted by facility operation.	Grab samples collected weekly and composited monthly
Liquid/ Bottom Sediment (e)	Two samples (BS1, BS2) to be taken from the bottom of Bluegill Pond near the surface water sites.	Collected semi-annually

TABLE 6.2-1
SUMMARY OF ENVIRONMENTAL RADIOLOGICAL MONITORING
SAMPLING SITES - OPERATIONAL PROGRAM - footnotes

(a) The number, media, frequency, and location of samples may vary from site to site. This table presents an acceptable minimum program for a site at which each entry is applicable. The code letters in parenthesis (i.e. AP1, SW2) provide one way of defining generic sample locations and can be used to identify the specific locations during the exact designation of each sample site.

(b) Air particulate samples will be collected on filters attached to continuously operating air samplers.

(c) Water samples will be collected using water collection buckets, bottles, pumps, etc. and stored in clean containers. Surface water samples will be collected weekly and then composited on a monthly basis - this monthly composite will be analyzed.

(d) Soil samples will be collected using scoops, shovels, etc. as appropriate.

(e) Bottom sediments will be collected using a device that will gather the top surface of the sediment, not to reasonably exceed a depth of six to eight inches. The sampling locations should be selected in conjunction with anticipated concentrations of facility-related radionuclides or in conjunction with the surface water sites.

(f) Sufficient volumes of samples will be collected when available, using accurate sample collection methods to ensure the attainment of Lower Limits of Detection as specified in Table 6.1-4.

(g) Samples collected will be sent to an appropriate laboratory for analysis via a reliable shipping organization. A sample transmittal form will accompany the samples. Samples will be packaged in a manner to ensure the integrity of each during transit.

(h) Gamma and alpha spectroscopy will be performed on all samples collected. Some sediment, soil, and air samples may not provide valid alpha spectroscopy data in which case gross alpha measurements will be performed. Alpha spectroscopy can be performed via chemical or radiological techniques, depending on current technology.

NOTE: The number, media, frequency, and location of samples may be modified to reflect the facility's operating history and other information.

Table 6.2-2
SURFACE WATER CHEMISTRY MONITORING PROGRAM

Physiochemical Measurement	Analytical Methodology
pH	Electrode
Conductivity	Electrical Conductance
Transparency	Secchi Disk
Turbidity	Nephelometric
Total Suspended Solids	Gravimetric
Dissolved Oxygen	Probe
Alkalinity	Potentiometric Titration
Calcium	AA/ICP
Magnesium	AA/ICP
Potassium	AA/ICP
Sodium	AA/ICP
Chloride	Colorimetric
Fluoride	Colorimetric
Hardness ($CaCo_3$)	Equivalency Calculation
Silver	AA/ICP
Beryllium	AA/ICP
Antimony	AA/ICP
Zinc	Cold Vapor AA
Thallium	AA/ICP
Arsenic	AA/ICP
Selenium	Colorimetric
Cadmium	AA/ICP
Chromium	AA/ICP
Copper	AA/ICP
Nickel	AA/ICP
Lead	AA/ICP
Sulfate	Turbidometric
Total Organic Carbon	TOC Analyzer
Nitrite & Nitrate Nitrogen	Colorimetric
Ammonia Nitrogen	Colorimetric
Total Phosphorus	colorimetric

Abbreviations - AA = Atomic Absorption Spectrophotometry
- ICP = Inductively Coupled Plasma - Atomic Emission Spectroscopy
- Probe = Specific Ion Probe

Table 6.2-3
GROUNDWATER WATER CHEMISTRY MONITORING PROGRAM

Physiochemical Measurement	Analytical Methodology
Temperature	Thermistor Thermometer
pH	Electrode
Conductivity	Electrical Conductance
Total Suspended Solids	Gravimetric
Total Solids	Gravimetric
Total Alkalinity	Potentiometric Titration
Calcium	AA/ICP
Magnesium	AA/ICP
Potassium	AA/ICP
Sodium	AA/ICP
Chloride	Colorimetric
Fluoride	Colorimetric
Hardness ($CaCo_3$)	Equivalency Calculation
Silver	AA/ICP
Beryllium	AA/ICP
Antimony	AA/ICP
Zinc	Cold Vapor AA
Thallium	AA/ICP
Arsenic	AA/ICP
Selenium	Colorimetric
Cadmium	AA/ICP
Chromium	AA/ICP
Copper	AA/ICP
Nickel	AA/ICP
Lead	AA/ICP
Sulfate	Turbidometric
Total Organic Carbon	TOC Analyzer
Nitrite & Nitrate Nitrogen	Colorimetric

Abbreviations - AA = Atomic Absorption Spectrophotometry
- ICP = Inductively Coupled Plasma - Atomic Emission Spectroscopy
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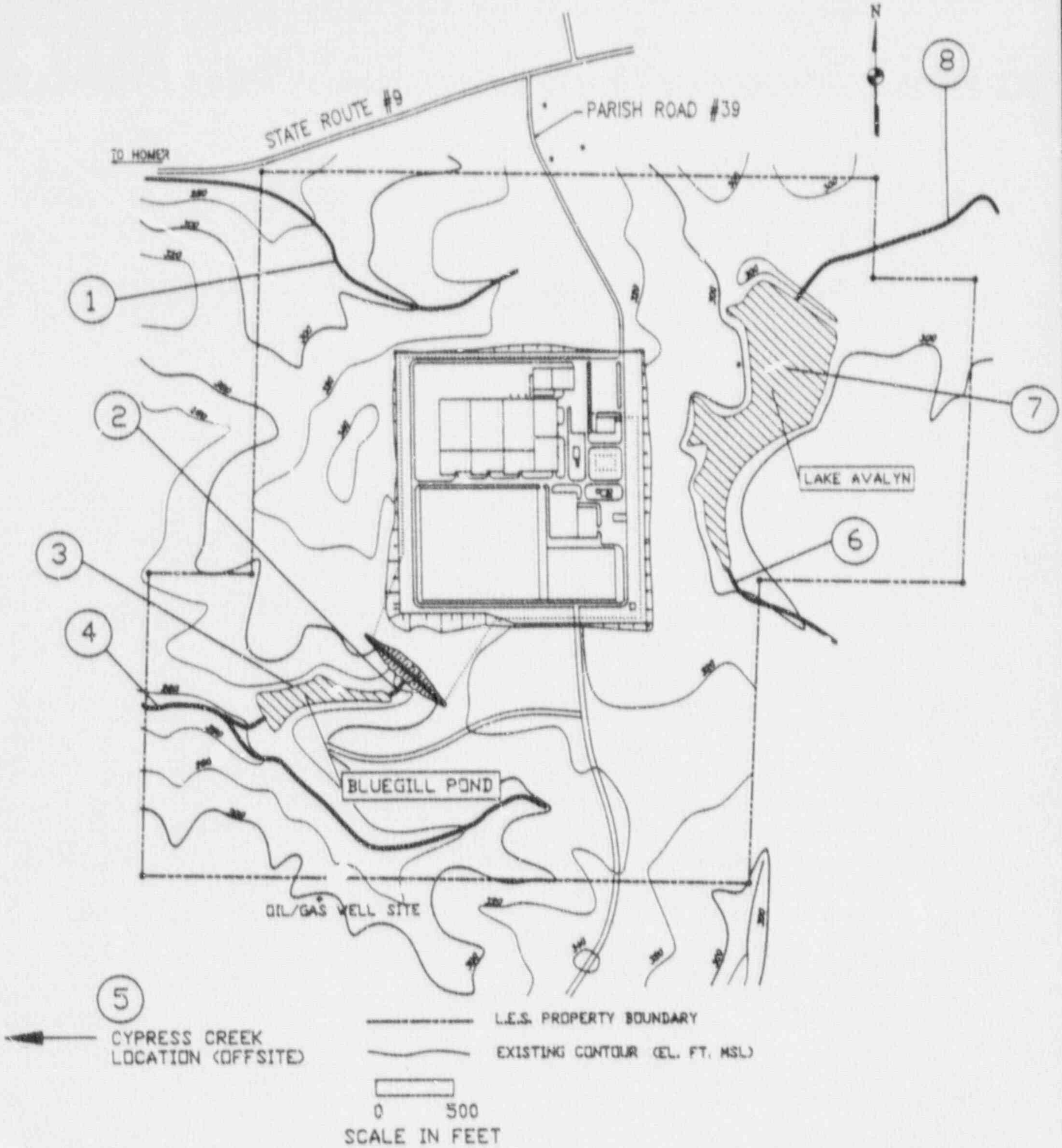

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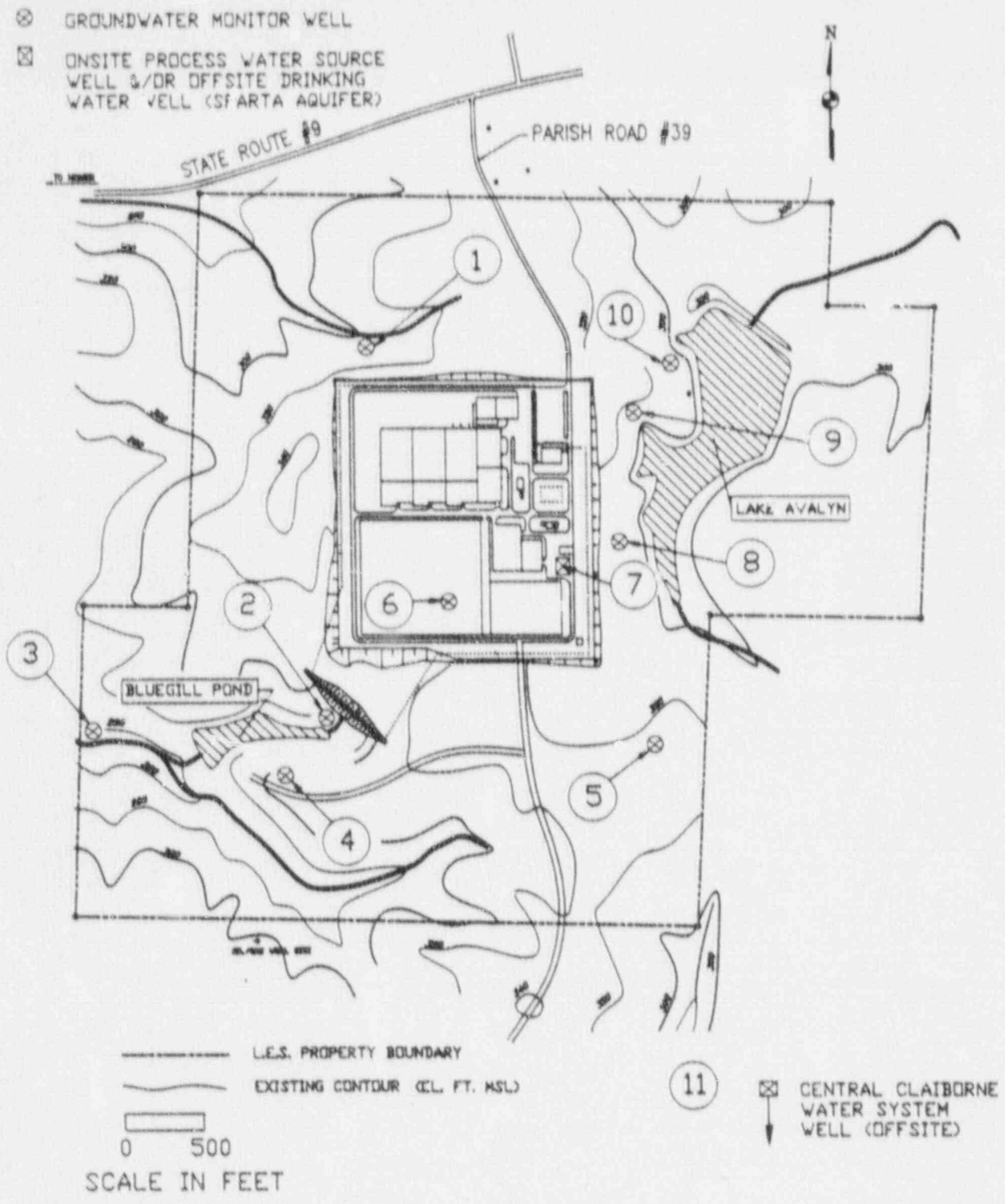
Surface Water Chemistry Monitoring Locations

Figure 6.2-1



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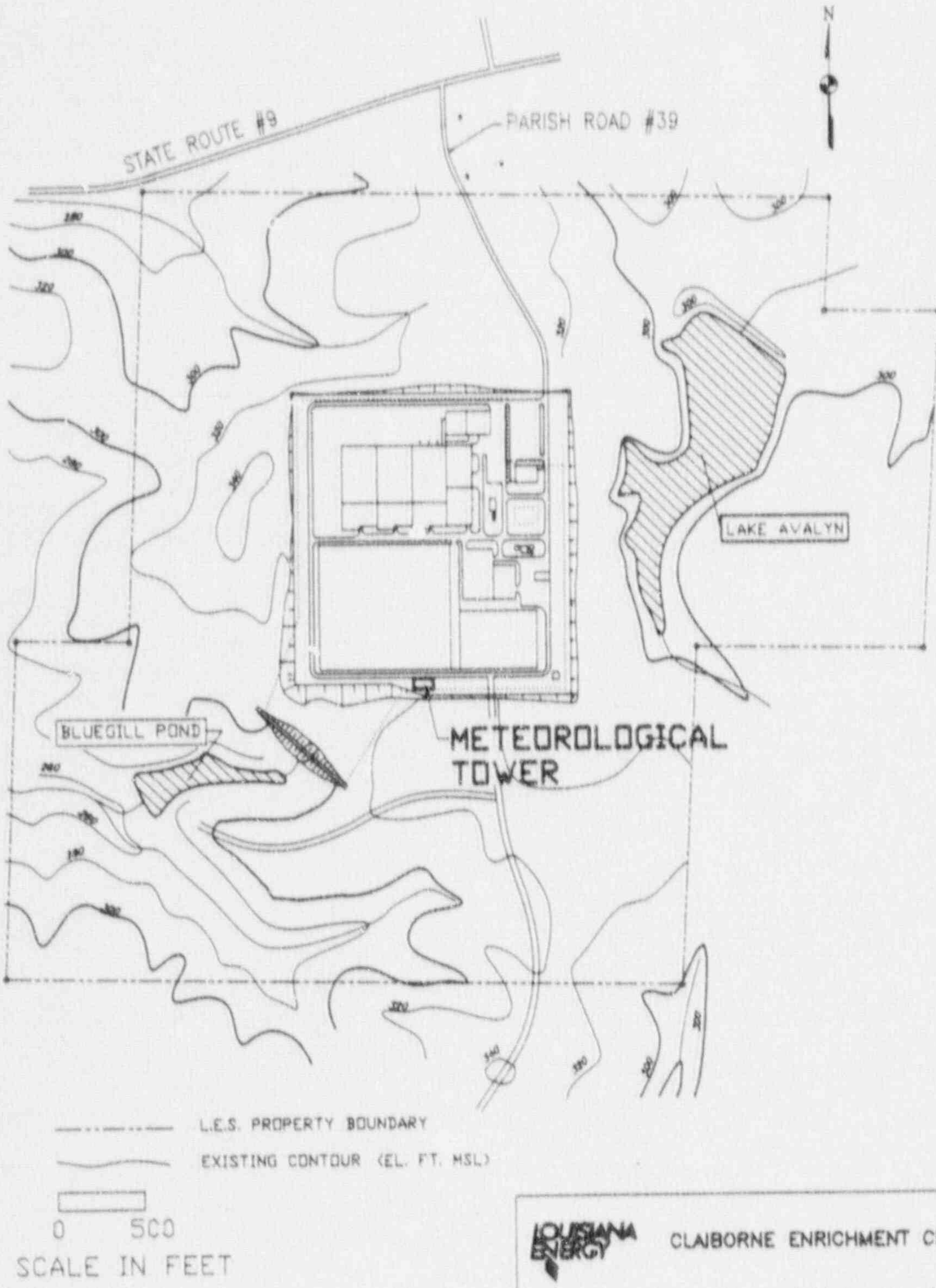
Ground Water Chemistry Monitoring Locations

Figure 6.2-2



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Location of Meteorological Instrument Tower

Figure 6.2-3

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6.3 RELATED ENVIRONMENTAL MEASUREMENT/MONITORING PROGRAMS

In order to aid in the assessment of the accuracy and precision of the sampling and analyses programs, the licensee will participate in appropriate check programs with State and/or Federal agencies, as available. This could include, but not be limited to, split samples with State agencies and cross check programs with the U.S.E.P.A. The licensee will supply the appropriate data to the participating agency for purposes of comparison and the agency will forward the results of the comparison to the licensee.

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7.0 PLANT SITING AND DESIGN ALTERNATIVES

Presented in this chapter is a description of the site evaluation/selection process and the viable design alternatives considered for the CEC. The LES enrichment facility employs the gas centrifuge technology developed by Urenco, a European consortium that provides commercial uranium enrichment services to utilities around the world. The gas centrifuge process is the most advanced, commercially feasible technology for enriching uranium available today. Urenco successfully operates three similar facilities in Europe near medium sized urban areas.

The nature of the gas centrifuge process along with the design features of the LES facility are such that adverse impact to the environment and surrounding area and residents will be insignificant. The character and appearance of the LES facility will be inconspicuous, more like a hospital or office complex than an industrial facility. There will be little or no noise off site produced by the facility. There will be no odors, smoke or other objectionable discharges from the facility.

Because of the very low environmental impacts associated with facility construction and operation, the CEC will be virtually benign to the environment in which it is located. For this reason the site evaluation process initially focused primarily on geotechnical, engineering and other factors and focused more strongly on environmental factors after the site screening process had identified a group of particular sites that satisfied the facility's engineering and other needs. Prior to the final evaluation of this group of particular sites, site screening was primarily a matter of evaluating locales to determine whether they were suitable for reliable, economic operation of the relatively environmentally benign centrifuge technology. The key environmental issues involve not so much the impact of the facility on the environment, which of course was determined, but rather involve assuring that the final group of alternative sites are not themselves unduly environmentally sensitive (e.g., assure that wetlands, parkland, endangered species/habitat, and historically significant areas are avoided or that impacts are adequately mitigated).

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7.1 FACILITY SITE SELECTION ALTERNATIVES

The purpose of the site selection process was to locate a suitable site for construction and operation of the LES CEC based on various technical, safety, economic and environmental factors. The methodology used for the site selection process was a systematic screening approach starting with coarse screening of the contiguous United States, eliminating problem areas and defining a preferred area. Next, intermediate screening criteria were applied, on a consistent basis, to determine potential plant areas/communities within the preferred area and further to determine the preferred community. Finally, fine screening criteria were applied to the candidate sites for selection of the preferred and final site.

Environmentally based criteria were not employed as selection factors in coarse and intermediate screening phases. As described in Chapter 4, all liquid and gaseous releases from the facility are such that operation of the CEC is relatively benign, with no significant adverse effect on the environment. For this reason, the CEC could be located in any region of the country from an environmental impact standpoint.

The following plant/site characteristics were held in consideration during the site selection process:

- The enrichment facility is best characterized as a specialty chemical plant. It takes in a particular chemical feed, processes it, and yields a product.
- The facility requires a medium size site (i.e., hundreds of acres), but not a huge site (i.e., thousands of acres). Most of the land is buffer zone, not building.
- The facility requires good road access for trucks to bring in feed material and ship out product material. Feed and Product are not expected to be moved by rail or air.
- The facility requires an adequate, reliable supply of electrical power.
- The facility requires a source of workers who are capable of operating the plant efficiently and safely.
- The durability and reliability of the process system is dependent on locating in an area that exhibits minimal seismic activity.
- The plant should be located in an area that does not

experience severe winds and associated risk of flooding.

- The site should not be flood prone in order to prevent damage to expensive equipment. This also obviates the need for flood proofing of the site.

- The facility should be developed in a locale where it would be considered an asset to the community.

7.1.1 COARSE SCREENING: REGIONAL SITE SELECTION ALTERNATIVES

This screening process selects a region of interest within the United States. Following are the criteria and rationale used to identify the most attractive region for locating the facility.

1. <u>Plant Sponsorship Factors</u>
Among the sponsors of the LES facility are several electric utilities. Siting of the facility in or near the service area of one of these utilities presents several advantages. One advantage is that the local utility sponsor is a well known business organization in that area. By contrast, the LES facility is being developed by a new company which would be viewed as a stranger in the community. Affiliation with a local utility would be helpful in promoting acceptance of the project. A second advantage of being located in a utility sponsor's state is that it would allow the project to make use of the utility's knowledge of the regulatory system in that state. Efforts to comply with regulatory requirements should be more straightforward if LES were to have access to utility personnel who are familiar with the requirements of state and local agencies. Figure 7.1-1 shows the service areas of the utility sponsors of LES. Plant sites located within or near these service areas would be more desirable than sites located elsewhere.

2. <u>Transportation Factors</u>
Feed material must be shipped to the site. Finished product material must be shipped to users. It is desirable to minimize shipping distances. Shorter transportation distances tend to reduce associated environmental impact and transportation costs and increase the margin of safety. Thus, one factor that would make a region attractive would be a location that minimizes the transportation distance.

   Presently, non-enriched uranium hexafluoride (UF6) feed material is obtainable domestically from plants in Oklahoma and Illinois. The enriched UF6 may be shipped to: Hanford, Washington; Columbia, South Carolina; Wilmington, North Carolina; Windsor, Connecticut; Lynchburg, Virginia; or

Hematite, Missouri. The regions represented by a transportation analysis are shown in Figure 7.1-2. The map shows two circles. The radius of each circle is 600 miles which was chosen as a reasonable distance for consideration of truck travel. One circle encloses territory lying within 600 miles of the centroid of the two UF6 feed suppliers in Illinois and Oklahoma. The other circle encloses territory within 600 miles of the centroid of the six destination plants to which product may be shipped.

Figure 7.1-3 shows the area which is a subset of both circles. All land within this zone falls within 600 miles of the centroid of the feed suppliers and the centroid of the destination plants. Therefore, any area lying within this area would be attractive in regard to transportation.

3. <u>Seismic Factors</u>
About half of the total plant investment at the facility is in centrifuge equipment. Earthquakes are of concern for centrifuge technology because earthquake forces can damage centrifuge machines or impair their durability. To minimize the threat to plant investment, it is essential that the plant be located in a region having minimal risk of seismic activity. This is an economic concern, not a safety concern.

Seismic forces, expressed in gravitational units (g), are a result of the effective peak acceleration (EPA) of the ground motion. For reliable operation of the LES centrifuge machines, an EPA of 0.05g was chosen, based on recommendations of the manufacturer, as a maximum permissible value for locating the CEC.

Figure 7.1-4 is a map of the United States which shows the anticipated effective peak acceleration expressed in terms of gravitational units (g). There are several portions of the United States in which earthquake forces in excess of 0.05g are not expected. Plant sites located in areas having a rating of 0.05g or less are highly desirable for location of the centrifuge enrichment technology.

4. <u>Wind/Storm Factor</u>
Avoidance of areas that are subject to the effects of severe storms, such as hurricanes, is an important factor in selecting areas suitable for the LES site. Hurricane related consequences of major concern to the LES facility are: loss of off-site power; flooding of buildings and centrifuge machines; and wind damage to buildings and utility facilities.

A national map of peak wind speed (Figure 7.1-5) provides an indication of the areas of the country which are likely to experience the most severe winds. Figure 7.1-6 highlights all areas of the country where peak winds are not expected to exceed 70 miles per hour. Plant sites located in areas having a peak wind of less than or equal to 70 miles per hour are desirable for location of the facility.

5. <u>Political Atmosphere</u>
Locating, licensing and operating an industrial facility requires the cooperation of a number of governmental agencies on the national, state and local levels. It is important to the success of the LES project to locate in a state possessing an atmosphere favorable to this type of industry.

6. <u>Climate</u>
Operation of the LES CEC depends on the movement and transport of both feed and product cylinders out-of-doors at the facility and over the highways. Severe winter weather in the form of ice and snow would adversely impact the continuous operation of the facility since it creates conditions that impede the movement of personnel and equipment and reduces the margin of safety of that movement. For this reason it is important to locate the facility in a region of moderate climate with a minimal amount of severe winter weather.

7. <u>Right-To-Work Laws</u>
Construction and operation of any industrial facility is greatly facilitated by a large labor pool available for employment. Therefore, it is advantageous to locate the LES CEC in a region or state having right-to-work laws, thus broadening the available labor pool to draw from since both union and non-union labor are included.

<u>Results</u>
Northern Louisiana was selected as the candidate region having the most favorable characteristics. In regard to the aforementioned criteria, this candidate region was selected for the following reasons:

- Plant sponsorship. Louisiana Power and Light, a LES partner, has service area in northern Louisiana.

- Transportation. Northern Louisiana is within the zone that is most attractive for transportation of feed and product.

- Seismic. Northern Louisiana is an area of low seismic activity. Seismicity studies that included northern Louisiana indicate that the area is one of the lowest seismic risk areas of the United States for near-field shocks (high frequency of vibration) and distant events (low frequency of vibration).

- Severe winds. Northern Louisiana is within the zone which experiences a peak wind speed that is less than or equal to 70 mph.

- The state of Louisiana actively pursues new industry and this attitude is evidenced at all levels of government - national, state and local. The government of the State of Louisiana has adopted a number of programs which are intended to attract new business into the state. Qualified new manufacturing businesses are exempt from ad valorem taxes for ten years. This amounts to a savings to LES of approximately $64 million. Under the Enterprise Zone concept, qualifying businesses can be exempted from state and local sales taxes and be eligible for certain tax credits. The Freeport Law is available to reduce certain taxes or delay their payments. The Louisiana Department of Economic Development pays for certain pre-employment training of workers.

- Louisiana features a warm, humid, sub-tropical climate with only occasional snowfalls minimizing the possibility of weather-related interruptions in operation.

- Of the states within service areas of the three utility plant sponsors, North Carolina, South Carolina and Louisiana have right-to-work laws in effect, thereby allowing the entire labor pool of each state available for employment at the LES facility.

7.1.2 INTERMEDIATE SCREENING

The intermediate screening process consists of two phases. Phase I identifies candidate areas or communities within northern Louisiana that meet the screening criteria. Phase II, through comparative analyses, identifies the final candidate community.

7.1.2.1 Intermediate Screening - Phase I

Communities in northern Louisiana within 45 miles of interstate 20 were solicited for expressions of interest in hosting a new manufacturing facility. The Louisiana Department of Economic Development (DED) assisted in contacting appropriate community leaders and conducting community/site visits. The candidate communities were asked to nominate potential sites based on the following criteria:

1. The proposed facility would be a chemical plant.
2. Site size should be between 300 and 1000 acres.
3. Sites with square configuration are preferable.
4. Single ownership is preferable.
5. It is preferable if the site owner is motivated to sell.
6. Sites are preferable if they do not have operating oil wells.
7. Sites with good access are preferable.

Responding to the inquiries were 21 communities in northern Louisiana. Consideration of the following criteria by site selection personnel during visits to each of the communities reduced to 9 the number of candidate communities for further consideration.
Criteria:

1. Must have active, cohesive community leadership (mayor, police jury, economic development group).
2. Must be located in LP&L service area.
3. Must have stable soils (i.e., not prone to subsidence).
4. Available sites must not be flood prone.
5. Must have a strong manufacturing mentality conducive to new industry.
6. Must have good highway access to I-20.
7. Avoid communities with an existing major industrial facility that would be a competitor for industrial resources.
8. Avoid large urban areas.
9. Avoid property with operating gas/oil wells.
10. Compatibility with neighboring land use.

The twelve responding communities that were not retained for further consideration are listed below along with the reasons for their elimination from the site evaluation process.

1. Rayville - poor site configuration
2. Tallulah - unstable soils, possibility of flooding
3. Bastrop - large paper mill
4. Ruston - academic community; not manufacturing oriented
5. Spring Hill - large paper mill
6. Plain Dealing - not LP&L service area
7. Shreveport - too urban, high land costs
8. Vivian - not LP&L service area
9. Oil City - not LP&L service area
10. Armistead - not LP&L service area, flood prone
11. Farmerville - lacks a cohesive leadership group; not manufacturing oriented
12. Lake Providence - unstable soils, flood prone

7.1.2.2 Intermediate Screening - Phase II

The purpose of this phase was to select the final candidate community from the nine potential communities under consideration. The methodology used for the remainder of the site selection process was the Kepner Tregoe (K-T) method of decision analysis (Reference 1). This widely accepted method for comparison of alternatives on the basis of multiple criteria is used frequently in alternative site comparisons. Criteria are divided into those that must be met by an alternative (musts) and those that are desirable for an alternative to meet (wants). The wants are weighted according to relative importance.

The weights assigned to the various criteria and the ratings assigned to the communities were determined by LES site evaluation professionals based on their experience and knowledge of LES' requirements. The weights and ratings are for comparative purposes only and are not absolute values.

Following are the criteria used:

1. LP&L Electrical Services Availability (Must). LP&L must be able to provide the site with 22 megawatt service. Since reliability of service is essential, the ability to install redundant feeders is required.
2. Facility Distance (Must). The LES facility must be located at least 20 miles from any nuclear power plant or nuclear fuel facility to avoid interaction environmentally or in terms of emergency preparedness. Also should be located at least 5 miles from military munitions depots or large facilities which make or store hazardous chemicals.
3. Proximity to I-20 (Must). Must be within 45 miles of I-20.
4. Geologic/Soil Conditions (Must). Area must be free of known, documented fault zones and have stable soils suitable for building foundations.
5. Local Support (Want-Weight=10). Support of the entire community is a tremendous asset to the successful construction and operation of the facility.
6. Opinion Leader Unity (Want-Weight=10). Development of the LES CEC will be greatly facilitated if dealing with an active and cohesive group of community leaders.
7. Availability of Operating Personnel (Want-Weight=10). An adequate supply of technically trainable people in the immediate area is important for facility staffing as well as aiding in gaining acceptance by a community.
8. LES Position As Dominant Industry (Want-Weight=9). Operation of the LES facility could be hampered by the presence of an existing industrial facility in terms of competition for employees or community services.

9. Livability (Want-Weight=9). Morale of plant workers will be higher in a locale with a better quality of life. In instances where required skills are not available locally, a good quality of life will be very helpful in recruiting people from outside the area.
10. Distance To Metro Area (Want-Weight=8). Locating within a reasonable driving/commuting distance to either Shreveport or Monroe is important in terms of availability of materials or services.
11. Manufacturing Mentality (Want-Weight=7). Locating in a community that regards industry as an asset is desirable.
12. Land Cost (Want-Weight=6). Minimizing the expense of property acquisition is desirable.
13. Availability of Maintenance Services (Want-Weight=6). Construction and operation of the CEC will require a number of various maintenance services. It is preferable to locate in an area where such services are already available.
14. Financial Incentives (Want-Weight=5). Incentives offered by communities for CEC locating in the area are an important consideration and an aid to development of the facility.

Results

The results of the K-T analysis comparing the nine communities are shown in Figure 7.1-7.

As evidenced by the total scores, there is very little difference between several of the higher ranking communities and choosing an adequate site in any of them would be possible. In the interest of conducting the site evaluation process in a reasonable amount of time, the highest ranking community (731), Homer in Claiborne Parish, was chosen for further evaluation.

The community of Homer contained six potential sites which were analyzed and compared in The Fine Screening Process.

7.1.3 FINE SCREENING

This stage of the site evaluation process consists of two phases. Phase I begins with the six potential sites and by K-T analysis identifies the three most preferred. Phase II K-T analysis compares the remaining three sites and identifies the final selected site.

7.1.3.1 Fine Screening - Phase I

The six sites around Homer were compared in this phase and the three with the highest K-T scores were retained for the final analysis. Following are the eight selection criteria used in this phase.

1. Low Flood Risk (Must). Flood proofing of a flood prone site would be costly and could increase environmental impact caused by the facility. Sites that are flood prone are not acceptable.
2. Community Leader Preferences (Want-Weight=10). Opinion leaders in Claiborne Parish provided their views regarding which sites would be most appropriate for the CEC.
3. Good State Highway (Want-Weight=8). All feed and product will be shipped by truck. Heavy-duty roads, such as the state highway system, will be used to access I-20. Scores for this criterion were based on the sites proximity to state highways in good condition.
4. Low Adjacent Population (Want-Weight=8). Low population density within a 2 mile radius of the facility is considered desirable.
5. Institutions Within Five Miles (Want-Weight=8). Similar to criterion 4 above, it was considered desirable to locate at least 5 miles from institutions such as schools, hospitals, or nursing homes.
6. Total Land Price (Want-Weight=5). This was based on asking prices solicited from the land owners.
7. Site Shape (Want-Weight=4). Properties are more desirable with a relatively square configuration so the facility can be centrally located with a surrounding buffer area.
8. Topography of Site (Want-Weight=4). The most attractive sites are those with sufficient relief to be well drained with a higher, level area at the center.

Results

Table 7.1-8 indicates the results of the K-T analysis based on the above criteria. The table also includes comments at the bottom. The top rated site, LeSage, was recommended for selection, pending confirmatory on-site studies. The second rated site, Emerson, was carried forward to the next phase as an alternative to LeSage. The site with the third highest numerical rating, Baptist Children's Home, was disqualified because some of it is vulnerable to the 100-year flood (i.e., it did not pass the must test). The fourth rated site, Prison, was carried on to the next phase as an alternative to LeSage.

7.1.3.2 Fine Screening - Phase II

During this phase the three sites were examined in more detail in order to select a final site. Preliminary geotechnical, environmental, and site specific information was collected on-site (Reference 2). Geotechnical information was collected primarily to address site suitability for building foundations and extent of remedial earthwork measures necessary to construct and operate the facility. Property contamination information was collected to address potentially existing contamination from previous activities on the properties and the extent of potential remedial activities necessary. Engineering estimates were made of grading costs and costs to provide electric power. An environmental review of the properties was conducted to determine previous land uses, proximity to national and state forests, wetlands, wildlife, and areas of scenic, historical or archaeological significance. The results were incorporated into the Kepner Tregoe analysis that had been developed during phase I of the fine screening.

Criteria

The following five criteria were added during Phase II:

1. Preliminary Environmental Evaluation (Want-Weight=8). This score reflects the overall environmental rating.

2. Property Contamination Mitigation (Want-Weight=8). This score reflects a rating of the extent of remedial measures that may be necessary due to contamination of the soil and waters from previous uses of the property. The lower the rating, the greater the potential for mitigation of contamination.
3. Cost of Providing Electric Power (Want-Weight=5). These scores are based on LP&L estimates for cost to connect the site to the grid.
4. Site Work and Grading cost (Want-Weight=5). These scores are based on estimates of cost of site work and grading at the sites.
5. Preliminary Geotechnical Evaluation (Want-Weight=5). This score reflects the overall geotechnical and soils ratings.

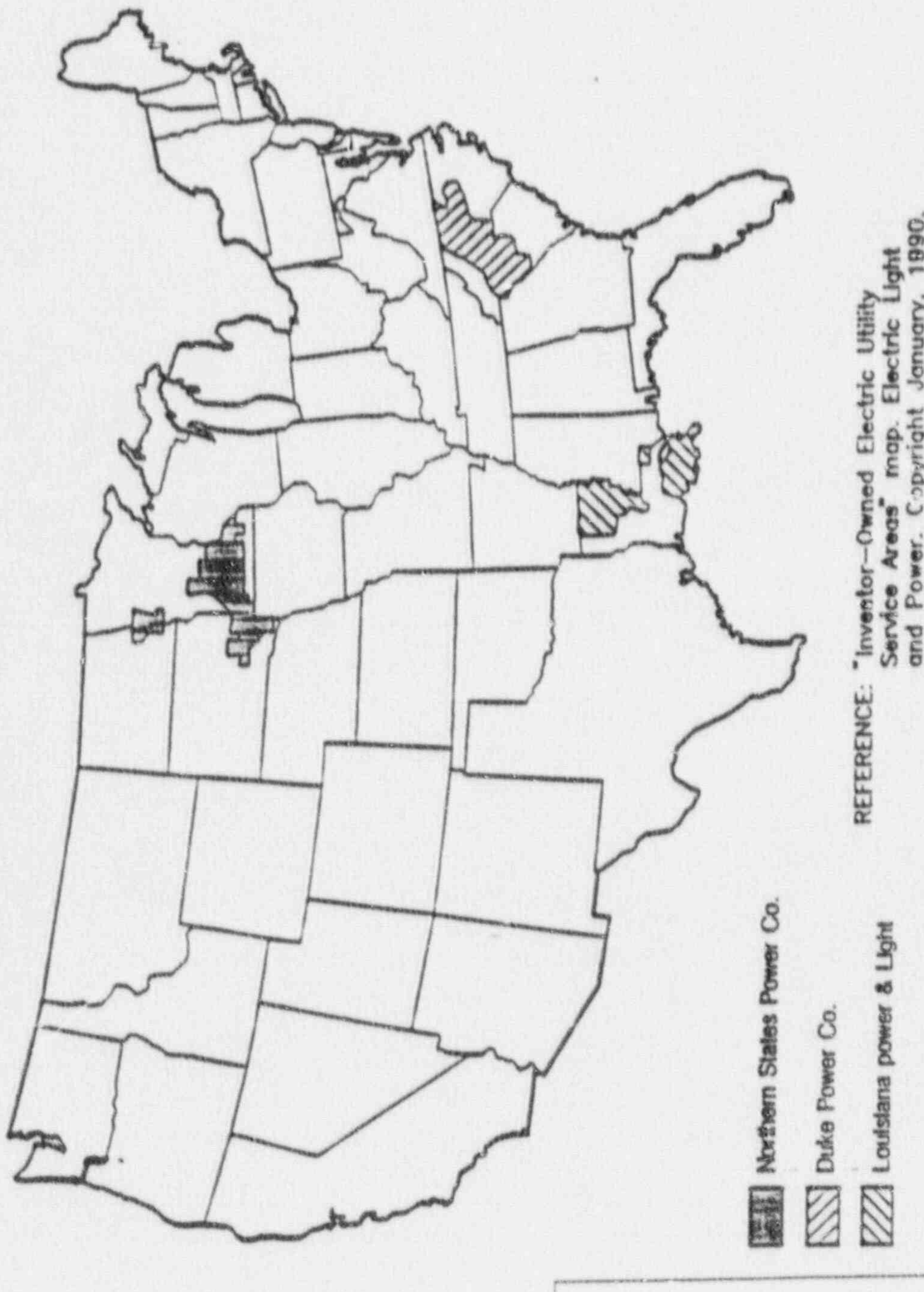
Results

Figure 7.1-9 shows the results of the Phase II - Fine Screening analysis. All three properties are adequate sites for locating the CEC and relatively indistinguishable in their environmental characteristics. The LeSage property received the highest rating and is the recommended site for the CEC, with the other two sites remaining as suitable alternatives. In-depth studies (Chapter 2) were then conducted on the LeSage property to confirm the preliminary findings and verify that it is an adequate site for the CEC.

References for Section 7.1

1. The New Rational Manager, Charles H. Kepner and Benjamin B. Tregoe, Princeton Research Press, 1981.

2. Report of Preliminary Geotechnical Study and Environmental Evaluation, Louisiana Energy Services Uranium Enrichment Plant, Claiborne Parish, Louisiana, Prepared for Duke Engineering and Services by Westinghouse Environmental and Geotechnical Services, Inc., Atlanta, Ga., August 18, 1989.



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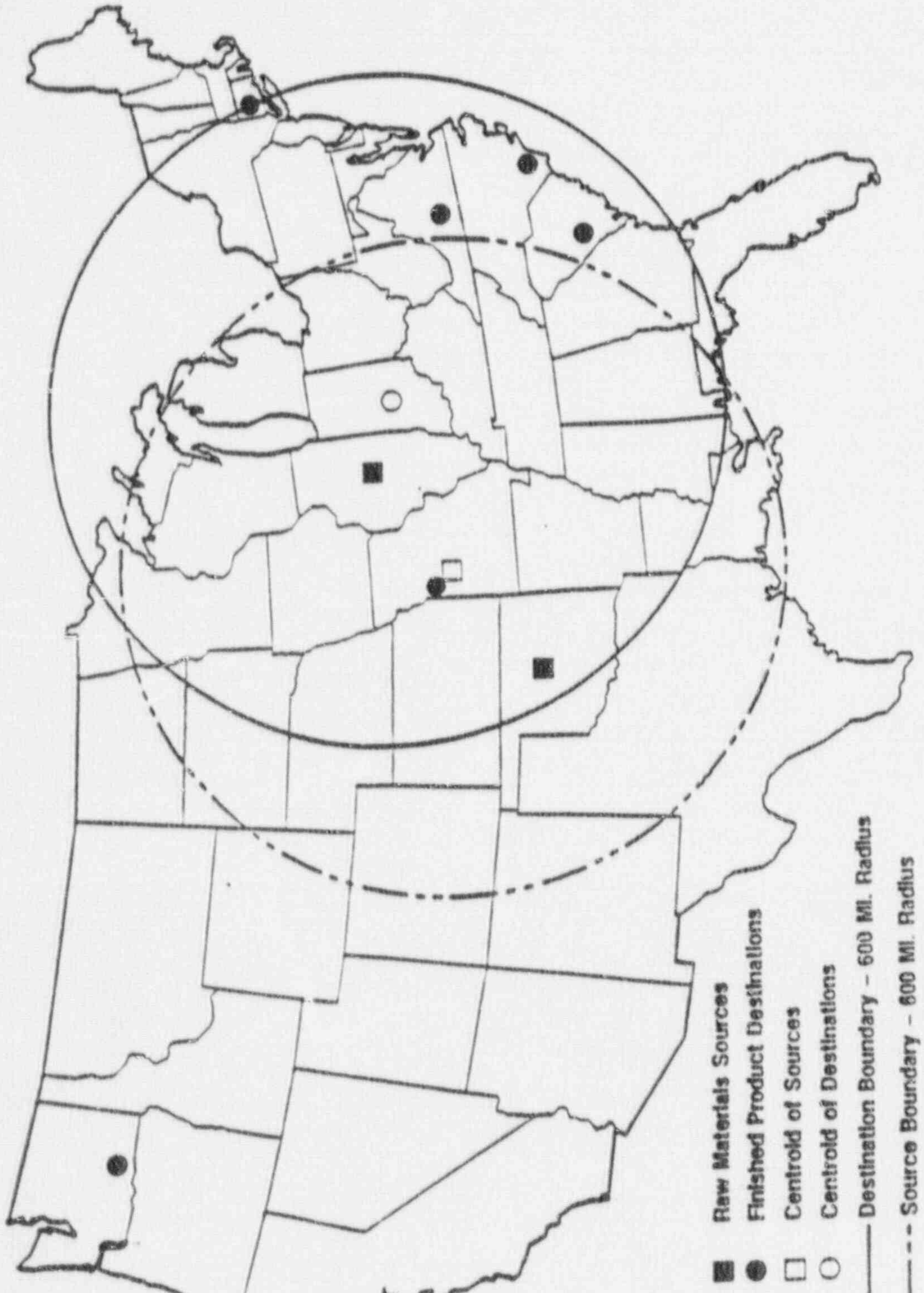
Investor Utility
Service Areas

Figure 7.1-1



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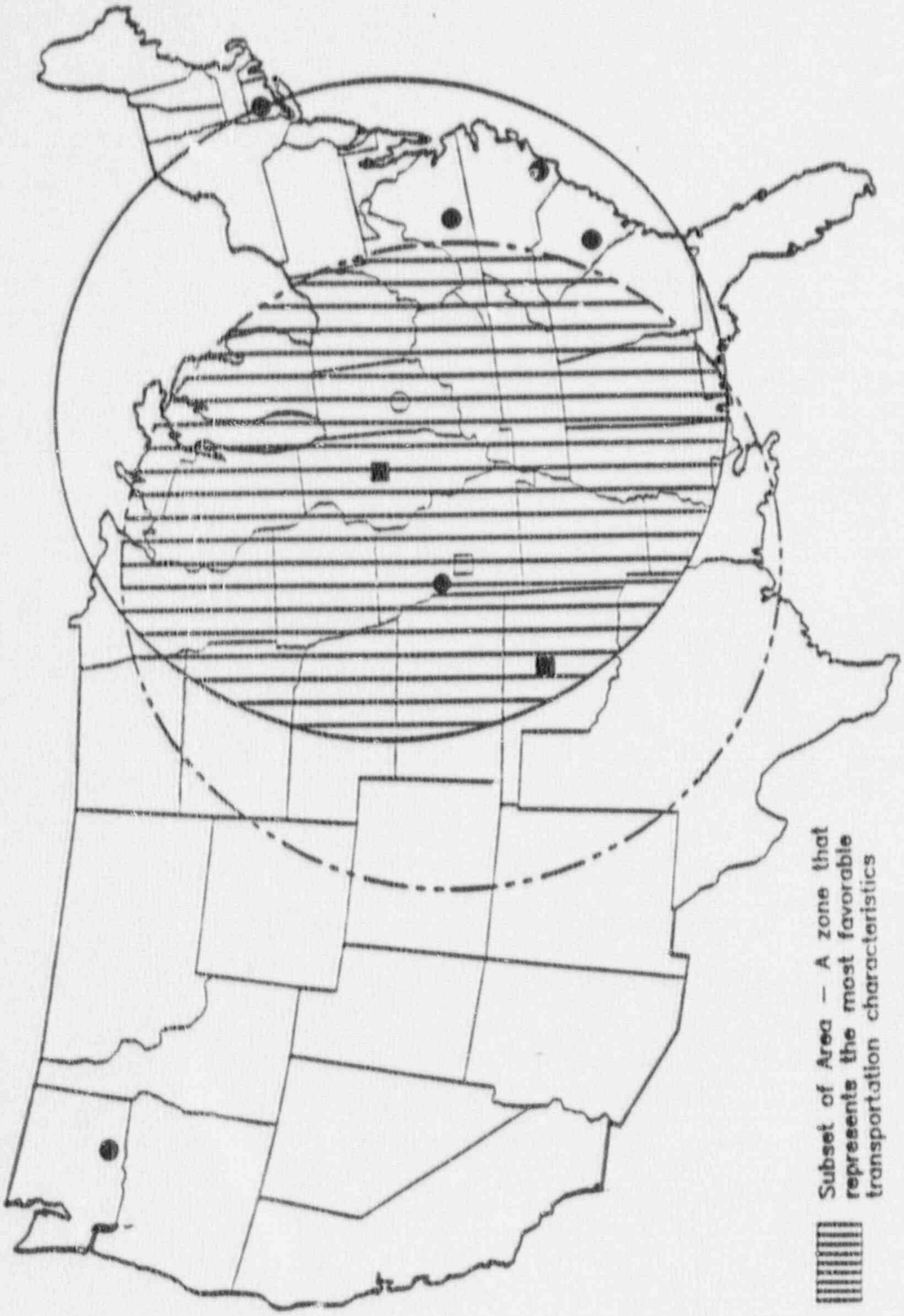
Locations of Feed Material Sources and Product Destinations

Figure 7.1-2



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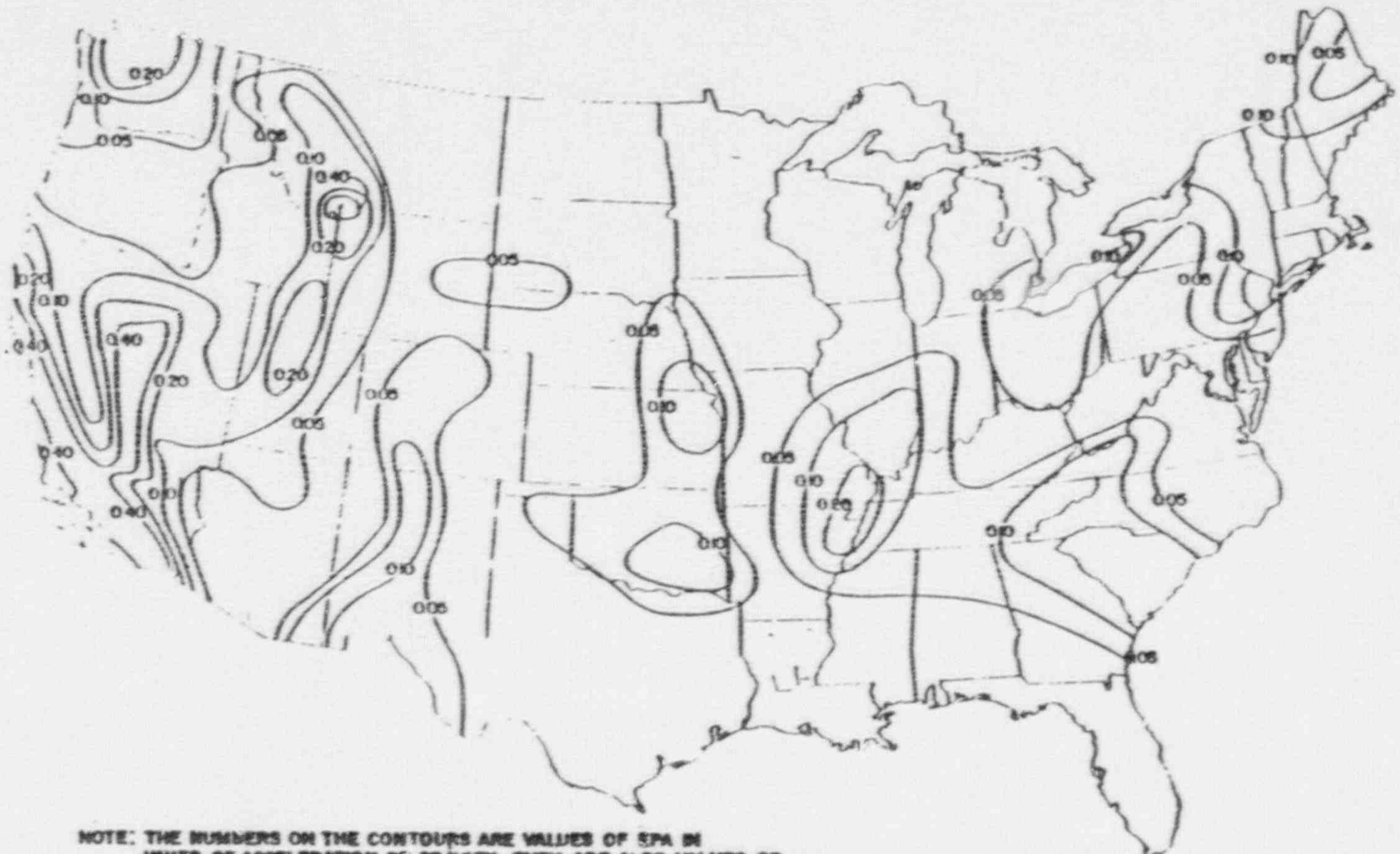
Favorable Transportation Region

Figure 7.1-3



NOTE: THE NUMBERS ON THE CONTOURS ARE VALUES OF EPA IN UNITS OF ACCELERATION OF GRAVITY. THEY ARE ALSO VALUES OF Aa IN EQU. C1-1 & WERE USED TO PREPARE THE MAP IN FIG.1 OF CHAPTER 1.

REFERENCE: "Tentative Provisions for the Development of Seismic Regulations for Buildings." Applied Technology Council, ATC3-06. U.S. Department of Commerce—National Bureau of Standards Special Publication 510.

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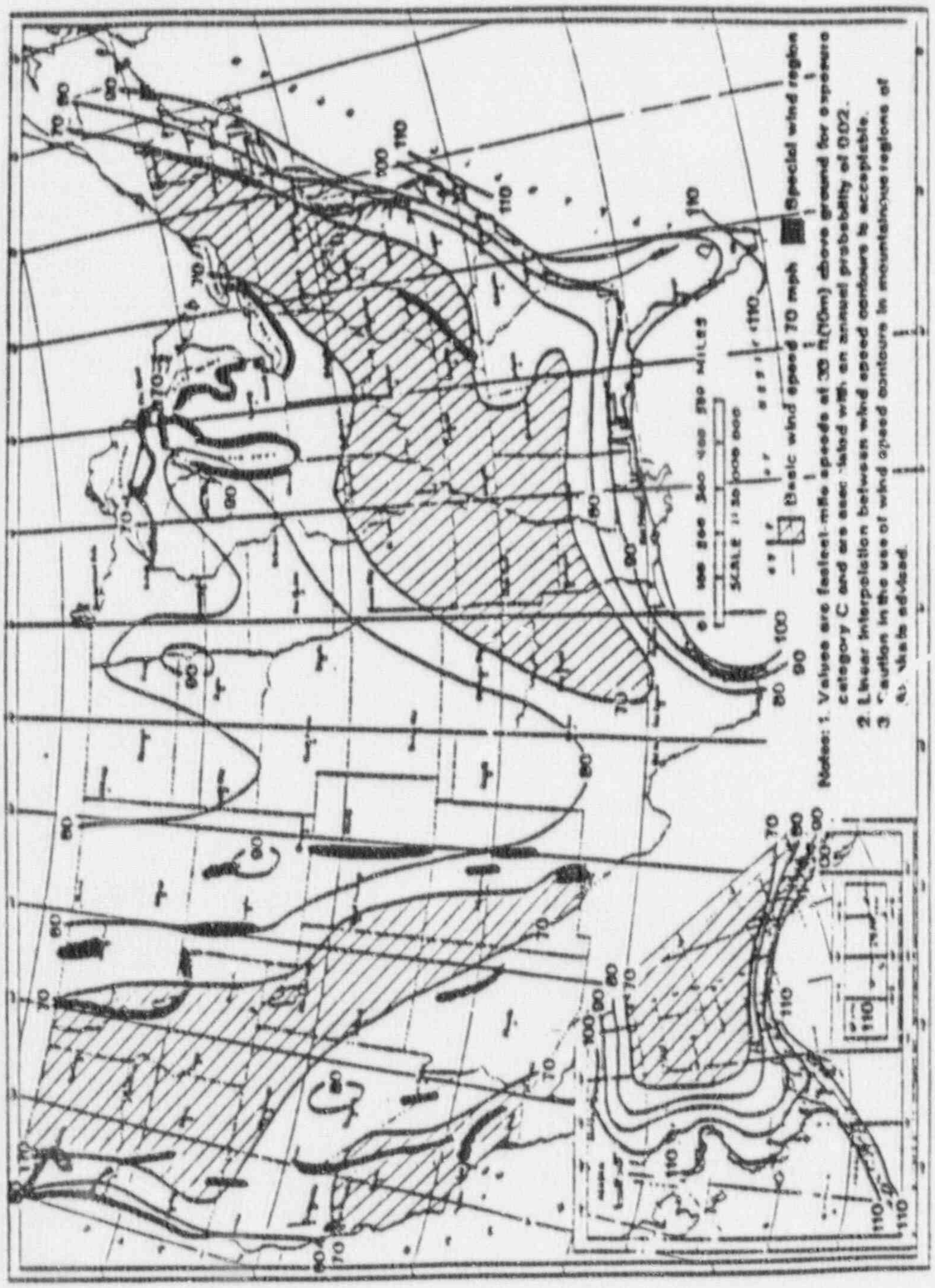
Contour Map For Effective Peak Acceleration

Figure 7.1-4

AMERICAN NATIONAL STANDARD A58.1-1982



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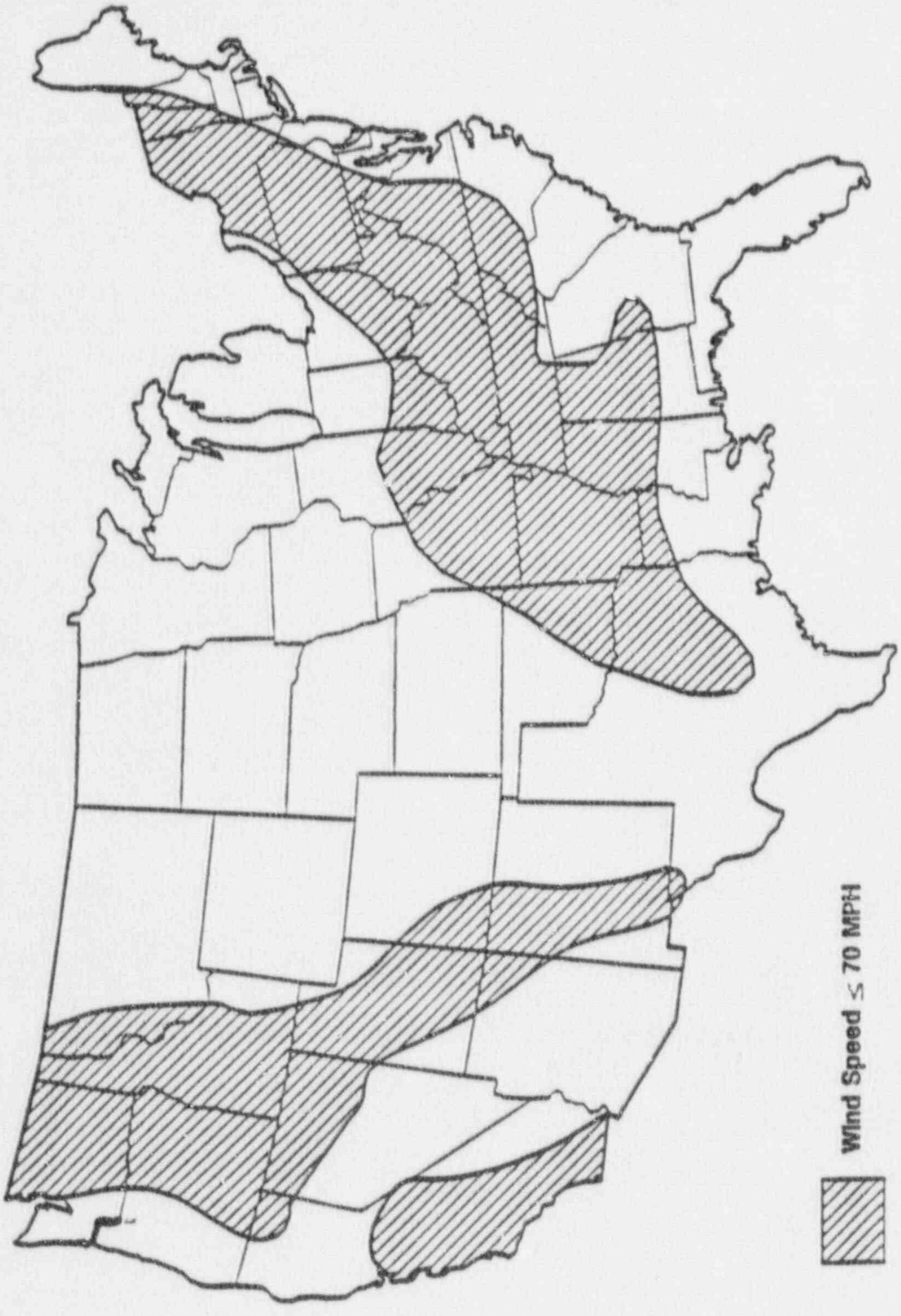
Basic Wind Speed
(Miles Per Hour)

Figure 7.1-5



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Wind Speed Zone

Figure 7.1-6

	WEIGHT	WINNSBORO		OAK GROVE		DELHI		GI
		SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE
1. LP & L ELECTRIC SERVICE	MUST	YES		YES		YES		
2. FACILITY DISTANCE	MUST	YES		YES		YES		
3. PROXIMITY TO I-20	MUST	YES		YES		YES		
4. GEOLOGIC/SOIL CONDITIONS	MUST	YES		YES		YES		
5. LOCAL SUPPORT	10	10	100	10	100	8	80	7
6. OPINION LEADER UNITY	10	10	100	10	100	8	80	6
7. AVAILABILITY OF OPERATIONAL PERSONNEL	10	9	90	6	60	9	90	7
8. LES POSITION AS DOMINANT INDUSTRY	9	10	90	10	90	8	72	10
9. LIVABILITY	9	8	72	5	45	10	90	6
10. DISTANCE TO METRO AREA	8	6	48	5	40	8	64	10
11. MANUFACTURING MENTALITY	7	10	70	5	35	10	70	5
12. LAND COSTS	6	9	54	10	60	10	60	6
13. AVAILABILITY OF MAINTENACE SERVICES	6	7	42	5	30	8	48	10
14. INCENTIVES	5	10	50	8	40	8	40	7
TOTAL SCORES			716		600		694	

NOTE:

EXPLANATION OF WEIGHTED SCORES---

WEIGHT X SCORE = WEIGHTED SCORE.

SLAND	COLUMBIA		RINGHOLD		ARCADIA		HOMER		MINDEN	
WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE
YES	YES		YES		YES		YES		YES	
YES	YES		YES		YES		YES		YES	
YES	YES		YES		YES		YES		YES	
YES	YES		YES		YES		YES		YES	
70	7	70	8	80	10	100	9	90	9	90
60	7	70	4	40	7	70	10	100	8	80
70	7	70	8	80	9	90	10	100	10	100
90	7	63	10	90	10	90	8	72	3	27
54	7	63	4	36	7	63	9	81	9	81
80	8	64	10	80	9	72	9	72	10	80
35	8	56	5	35	7	49	10	70	10	70
36	9	54	6	36	4	24	8	48	8	48
60	7	42	8	48	10	60	8	48	8	48
35	8	40	8	40	8	40	10	50	9	45
590		592		565		658		731		669

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

K-T Analysis
Intermediate Screening
Phase II

Figure 7.1-7

CRITERIA	WEIGHT	PRISON S	
		SCORE	WEIG SC
1. LOW FLOOD RISK - OUT OF 100 YEAR FLOOD PLAIN	MUST	YES	O
1. COMMUNITY LEADER PREFERENCES	10	10	1(
3. GOOD STATE HIGHWAY ACCESS	8	8	6
4. LOW ADJACENT POPULATION	8	10	8
5. INSTITUTIONS WITHIN 5 MILES	8	5	4
6. TOTAL LAND PRICE	5	10	5
7. SITE SHAPE	4	8	3
8. TOPOGRAPHY OF SITE	4	3	1
TOTAL SCORES			37
COMMENTS			

ITE	EMERSON SITE		LESAGE SITE		BAPTIST CHILDREN'S HOME		GLADNEY SITE		KING SITE	
HTED ORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE
K	YES	OK	YES		NO	DROP	YES	OK	YES	OK
10	9	90	9	90	7	70	2	20	0	0
4	10	80	10	80	7	56	10	80	8	64
0	7	56	9	72	10	80	9	72	7	56
0	8	64	9	72	10	80	9	72	7	56
0	8	40	9	45	10	50	5	25	8	40
2	10	40	10	40	6	24	10	40	10	40
2	8	32	10	40	7	28	10	40	10	40
8		402		439		388		349		296
	GOOD LAYOUT CLOSE TO HIGHWAY		GOOD FLAT SPOT IN MIDDLE OF SITE ALONG ROAD		DROP DUE TO SITE BEING PARTIALLY IN 100 YEAR FLOOD PLAIN					

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

K–T Analysis
Fine Screening – Phase I

Figure 7.1–8

CRITERIA	WEIGHT	PRISON SITE		EMERSON SITE		LESAGE SITE	
		SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE	SCORE	WEIGHTED SCORE
1. LOW FLOOD RISK - OUT OF 100 YEAR FLOOD PLAIN	MUST	YES	OK	YES	OK	YES	
2. COMMUNITY LEADER PREFERENCES	10	10	100	9	90	9	90
3. PROPERTY CONTAMINATION MITIGATION	8	8	64	8	64	10	80
4. PRELIMINARY ENVIRONMENTAL EVALUATION	8	9	72	10	80	10	80
5. GOOD STATE HIGHWAY ACCESS	8	8	64	10	80	10	80
6. LOW ADJACENT POPULATION	8	10	80	7	56	9	72
7. INSTITUTIONS WITHIN 5 MILES	8	5	40	8	64	10	80
8. TOTAL LAND PRICE	5	10	50	8	40	9	45
9. COST OF PROVIDING ELECTRICITY	5	10	50	6	30	7	35
10. SITEWORK & GRADING COSTS	5	6	30	9	45	10	50
11. PRELIMINARY GEOTECHNICAL EVALUATION	5	7	35	10	50	10	50
12. SITE SHAPE	4	8	32	10	40	10	40
13. TOPOGRAPHY OF SITE	4	3	12	8	32	10	40
TOTAL SCORES			629		671		742
COMMENTS		RAVINE/ WETLAND DOWN MIDDLE		GOOD LAYOUT CLOSE TO HIGHWAY		GOOD FLAT SPOT IN MIDDLE OF SITE ALONG ROAD	

LOUISIANA ENERGY

CLAIBORNE ENRICHMENT CENTER

K-T Analysis
Fine Screening - Phase II

Figure 7.1-9

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7.2 DESIGN ALTERNATIVES

This section deals with design aspects of the facility that could impact the environment and alternatives to the design aspects with respect to increased or decreased environmental impact.

Most of the environmental effects of an uranium enrichment facility are associated with the operation of certain identifiable systems. Outlined below are the systems and their features which have been, by design, incorporated into the facility to reduce the impact to the environment. Also, as appropriate, discussion is provided on possible alternatives to the design of the systems.

7.2.1 ENRICHMENT SYSTEM

The use of the gas centrifuge process for enriching uranium is much less energy intensive than the gaseous diffusion process. These two methods for enriching uranium are the only commercially viable methods currently being used on a large scale. For comparison, to produce the same amount of separative work (SWU) in a diffusion plant rather than a gas centrifuge facility requires approximately 50 times the amount of electricity. Therefore, using the gas centrifuge enrichment process instead of the gaseous diffusion process results in tremendous savings of those natural resources which are used to produce electricity.

7.2.2 SEWAGE TREATMENT SYSTEM

The Sewage Treatment System is described in detail in section 3.3. This system is the final treatment stage for all facility domestic sewage waste prior to release to the environment. There are two effluents from this system that could affect the environment: liquid effluent and sludge. The liquid effluent is monitored prior to release to ensure it meets or is below any limits imposed by the State of Louisiana, the Nuclear Regulatory Commission, the Environmental Protection Agency or other appropriate regulatory agencies. The sludge from the Sewage Treatment System is dried and sampled before it is sent to a local sanitary landfill. The Sewage Treatment System ensures releases to the environment are minimized. There are no significant design alternatives that could lower the impact on the environment.

7.2.3 LIQUID WASTE DISPOSAL SYSTEM

The Liquid Waste Disposal System is described in detail in Section 3.3. This system identifies, collects, stores, and processes liquid wastes generated in the Separations

Building that are potentially contaminated with radioactive material. These wastes are processed, if necessary, and then released to the Sewage Treatment System for eventual release from the facility. The entire system is designed and operated with an "as low as practicable" philosophy. There are no significant design alternatives that could lower the impact on the environment.

7.2.4 SEPARATIONS BUILDING VENTILATION SYSTEM

The Separations Building Ventilation System is described in detail in section 6.4.1 of the Safety Analysis Report. The cooling system for the Separations Building Ventilation System is described in detail in section 6.4.6 of the Safety Analysis Report. Approximately 78 million BTUs per hour are released from the cooling system into the atmosphere. Several alternate methods of providing the necessary cooling function are:

(a) Cooling Tower(s)
(b) Cooling Pond(s)
(c) Closed-cycle Spray System
(d) Electric Heat Pumps/Compressors

The release of 78 million BTUs per hour from the facility does not significantly impact the environment. The use of electric heat pumps/compressors is the best system for the facility because it minimizes the evaporation and use of water. The other systems require increased water usage. Using minimal amounts of water decreases the impact on the environment. Also, using a closed system prevents the creation of any fogging effects that are possible when cooling towers are used. Except for this design detail, no significant alternate designs were considered for the cooling system for the Separations Building Ventilation System.

7.2.5 GASEOUS EFFLUENT VENT SYSTEM

A detailed description of the Gaseous Effluent Vent System is presented in section 6.3 of the Safety Analysis Report. The purpose of this system is to evacuate and treat gaseous discharges from all UF_6 processes and remove any uranium and HF that may be present prior to release to the atmosphere.

The design of this system has evolved from Urenco's experience in operating gas centrifuge uranium enrichment facilities. The combination of chemical, aluminum oxide, and oil traps combined with filters, HEPA filters and activated carbon filters ensures that gaseous effluent from the facility contains as low as practicable amounts of contaminants and is well below any regulatory levels for allowable contaminant levels. There are no significant design alternatives that could lower the impact of the facility on the environment.

7.2.6 UF6 PROCESS SYSTEMS

The UF6 Feed System, Product Blending System, and Product Liquid Sampling System have all been designed to reduce the possibility of release of UF6. Detailed descriptions of these systems may be found in section 6.3 of the Safety Analysis Report. Whenever UF6 is above atmospheric pressure, a secondary containment has been designed to limit any possible release of UF6. This secondary containment is the autoclaves which are pressure vessels designed specifically to allow heating of UF6 while providing a secondary containment.

Autoclaves are used in all three of the above mentioned systems. Instead of autoclaves, steam chests could have been used to heat the UF6 cylinders. However, steam chests are not designed to withstand the same internal pressures as an autoclave. Therefore, the chances of an accidental release of UF6 are increased from the use of steam chests versus autoclaves. The use of autoclaves reduces the potential impacts of the facility on the environment.

Also, letdown stations which reduce the pressure of the UF6 process gas have been located within the feed autoclaves. This means that no UF6 above atmospheric pressure is ever outside an autoclave. Therefore, in the unlikely event that a pipe containing UF6 outside an autoclave were to break, there would initially be an in rush of air - not a release of UF6. In alternate designs of UF6 piping and autoclaves the letdown station could be located outside an autoclave. This would result in piping containing above atmospheric UF6 outside of an autoclave. Therefore, the design feature of locating letdown stations inside of autoclaves reduces the chances of an accidental release of UF6. The use of autoclaves reduces the potential impacts of the facility on the environment.

7.2.7 OTHER SYSTEMS

Other plant systems which could have an associated adverse environmental impact include the emergency diesel engines, and miscellaneous solid wastes.

The CEC maintains two diesel engines for emergency use during outside power loss. The engines are required for equipment protection and fire protection reasons and are not expected to be used during normal station operation except for routine testing.

Operation of the CEC results in slightly different transportation patterns of UF6 around the United States. However, this affect is minimal as the site was chosen because of its advantageous location to sites which supply or use the UF6 processed at the CEC.

Trash from the plant, including solid, non-radioactive chemical waste, is disposed of offsite in disposal areas meeting local and state requirements.

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8.0 BENEFIT-COST ANALYSIS

The benefits of the Louisiana Energy Services (LES) Uranium Enrichment Facility primarily accrue to the facility owners/investors, to the commerce and residents of Claiborne Parish, Louisiana and the overall nuclear industry in the United States. The nuclear industry realizes a significant benefit in that it gains a private domestic supplier of enriched uranium which utilizes a new, more economical technique for enriching low grade uranium hexafluoride feedstock. Also, the rate payers of utilities benefit from lower fuel costs.

A summary tabulation of the quantitative and qualitative socioeconomic benefits/costs associated with the construction and operation of the LES plant is presented in Tables 8.1-1 and 8.1-2, respectively. Descriptive evaluations of environmental benefits/costs relevant to the construction and operation phases of the LES facility are given in section 8.2.

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8.1 QUANTITATIVE AND QUALITATIVE SOCIOECONOMIC BENEFITS/COST: SITE PREPARATION AND PLANT CONSTRUCTION

8.1.1 QUANTITATIVE SOCIOECONOMIC BENEFITS/COSTS: SITE PREPARATION AND PLANT CONSTRUCTION

8.1.1.1 Value of Enriched Uranium

At full production levels, the LES facility produces 1.5 million separative work units (SWU) of enriched uranium product each year. Based on a 1990 market value of $110 per SWU, the added value of uranium enrichment services which is produced by the facility each year is approximately $165,000,000.

8.1.1.2 Tax Revenues

Tax payments resulting from the investment in the LES Claiborne Enrichment Center (CEC) facilities can be separated into ongoing property taxes and income taxes. Louisiana Energy Services forecasts annual property tax for the period 1990-2001 of $5,400 based on 1% of the $538,000 land cost. For the year 2002 and beyond, LES assumes property tax payments of 7.9 million annually. This figure is calculated by multiplying .75% times the initial book value of the facility.

Income taxes accruing from the investment in LES facilities are inherently more variable than property taxes due to the variability in annual tax depreciation applied to the LES investment. LES anticipates that the facility will generate taxable losses to its investors during the early years of operation; these taxable losses will reverse, becoming taxable income to its investors later in facility life. LES assumes a composite 37.7% tax rate and a nominal 0.3% local rate. Nominal annual tax liabilities in the years of taxable income to LES investors are projected to be in the range of $5 to $130 million.

8.1.1.3 New Jobs and Increased Local Income

Construction and industrial operating experience of the LES project owners provides the necessary background information needed to estimate the new jobs and projected increases in local income that will result due to the construction and operation of the LES enrichment facility.

A peak construction work force of 400 personnel is expected to be drawn from within Claiborne and surrounding Parishes. About 85 percent will live within commuting distance and approximately 12 percent will move into the Parish from other areas of Louisiana. Only about 3 percent of construction workers will be from out-of-state.

A major portion of the skilled labor force needed for and operating the facility is expected to be drawn from unskilled workers hired locally and trained by LES in on-the-job training programs.

About 180 full-time employees will be needed to operate the LES uranium enrichment facility. The estimated total annual operational payroll for the CEC in 1990 dollars will be approximately $8,000,000. This figure includes all costs including benefits. It is projected that the majority of this money will be spent in Claiborne and surrounding Parishes.

Expenditures for materials, equipment, and services associated with the construction and operation of the LES facility will represent a substantial addition to local as well as regional incomes. While major components of the facility including the centrifuge units are not manufactured locally, much of the other equipment and materials required for facility construction and operation will be purchased from qualified local and regional vendors.

In addition to direct construction and operating payroll costs, project monies are expended on services and supplies, much of which is available locally. Examples of such services and supplies include water treating chemicals, vehicle maintenance and fuel, miscellaneous hardware, food and clothing, janitorial supplies, pumps, motors, instruments and electrical equipment.

8.1.1.4 Capital costs of Land Acquisition

Purchase costs of the LES property tract was approximately $538,000.

8.1.1.5 Capital Costs of Plant Facility Construction

Direct capital cost of the LES plant facility construction including interest and property tax and input transmission facilities is projected to be approximately $800 million. This cost does not include escalation, capitalized interest, contingency or replacement centrifuges.

8.1.1.6 Facility Decommissioning Costs

A decommissioning cost study for the LES facility assuming a 1.5 million separative work unit (SWU)/year production rate for 30 years of operation has been made. Projected cost for the facility decommissioning were determined to be approximately $20,000,000 (1990 dollars) with an additional $9,500,000/year of operation for disposal of a single years production of UF6 tails. Detailed information pertaining to this study and projected costs are presented in Section 4.4.

8.1.1.7 Impact to Local Government for Services Required

No costs of the project to local government for required services is expected. No significant impacts in the areas of: housing;

inflationary effects on housing rentals or prices; noise or aesthetic disturbances; overloading of water supply and sewage treatment facilities, crowding of local schools, hospital or other public facilities or the overtaxing of community services is projected to occur.

8.1.2 QUALITATIVE SOCIOECONOMIC BENEFITS-COST: SITE PREPARATION AND PLANT CONSTRUCTION

8.1.2.1 Impact on Local Populace and Community Caused by Land Acquisition

No permanent residences were moved as a result of land acquisition for the LES facility and therefore no disruption to the local populace or the nearby community of Homer, Louisiana is expected to occur.

8.1.2.2 Impact on Local Services and Facilities

No significant impacts and/or overloads on local services and facilities will occur as a result of the construction and operation of the LES facility. During construction, wastes such as wood, concrete, and stumps, will either be buried on-site in an approved construction landfill area or shipped off-site for disposal in an approved landfill facility. Quantities of construction wastes which may be disposed of off-site should not significantly decrease existing landfill capacities.

Small quantities of chemical and sanitary wastes resulting from construction activities will be disposed of off-site in approved facilities. During operation, the LES facility has its own dedicated water supply, water treatment, chemical, radiological and sanitary waste treatment systems.

8.1.2.3 Impacts on Housing and Rental Costs

Some minor short-term increases to local housing and rental costs may occur during the construction phase of the project. No significant inflationary impacts to housing or rentals however is expected to occur over the long-term as a result of the LES project.

8.1.2.4 Impact on Local Roads and Highways

Some localized congestion along local roads accessing the facility site area may occur during work shift changes but no consistent long-term traffic congestion impacts will result due to the construction and operation of the LES facility.

8.1.2.5 Incentives to Other Industries

Construction and operation of the LES facility is not projected to either increase or decrease incentives for other major industries to locate within the local area. Service requirements of the facility (e.g., food, lodging accommodations, fuel, etc.) may however be sufficient to support the presence of several ancillary service type businesses in areas immediately adjacent to the plant.

8.1.2.6 Availability of Site Personnel and Equipment to Supplement Local Services and Facilities

No significant supplements to local services and facilities are expected to result because of the construction and operation of the LES facility in Claiborne Parish, Louisiana. Several of the operational personnel will be trained for special tasks such as fire fighting, first aid, chemical treatment and technical radiological analysis and may be made available should the need arise to supplement and augment any local service or community needs.

8.1.2.7 Impact on Local Recreational, Aesthetic and Scenic Values

The potential monetary impact of the LES facility on local recreational, aesthetic and scenic values is difficult to determine, but is not considered to be significant in either a positive or negative manner. Prior to its selection as the location for the LES facility, the site was privately owned and restricted from public uses such as hunting, camping and fishing. Timbering activities prior to plant construction by the previous land owner resulted in a temporary degraded visual condition which will not be further impacted by plant construction activities. The site has no known areas of historic or cultural interest.

8.1.2.8 Removal of Land from Present and Contemplated Future Uses

Prior to construction of the LES facility, the site property was in pasture and woodland. While some past uses of some of the land will be precluded by the facility, there will be a benefit due to the additional taxes paid for an industrial installation compared to those paid previously on unimproved land.

8.1.2.9 Impact on Real Estate Values in Adjacent Areas

It is anticipated that real estate values of some adjacent properties may be enhanced due to the presence of the LES facility. It is difficult however, to evaluate or quantify how and/or which adjacent properties may have their economic values increased. Property value enhancement would be gained primarily through the location of business ventures supporting LES operations (e.g., food service, equipment vendors).

TABLE 8.1-1

Quantitative Benefits/Costs of Socioeconomic Factors Associated With Plant Construction and Operation

One Time Benefit	
Claiborne Parish School Board Tax	$5,000,000.
Annual Benefits	
Value of enriched uranium enrichment services	$165,000,000.
Operating Payroll	8,000,000.
Tax Revenues (local/State/Federal)	
- Years 1990-2001	5,400.
- Year 2002 to end of facility life	7,900,000.
Personnel/business income(a)	21,000,000.
One Time Costs	
Land acquisition	$ 538,000.
Site selection, community relations and licensing	3,000,000.
Plant decommissioning	20,000,000.
Plant engineering & construction	800,000,000.
Annual Costs	
Operating and maintenance	$ 16,000,000.
Depleted Uranium Disposal	9,500,000.

(a) Based on 2.65 multiplier of primary dollars (i.e., payroll) for the Shreveport Economic Area which includes Claiborne Parish.

TABLE 8.1-2

QUALITATIVE BENEFITS/COSTS OF SOCIOECONOMIC FACTORS ASSOCIATED WITH PLANT CONSTRUCTION AND OPERATION

	Determination/ Evaluation
Qualitative Benefits	
• Incentive for development of other ancillary/support business development resulting from presence of LES facility	Potentially beneficial
• Availability of LES facility personnel and equipment to supplement local facilities and services	Potentially beneficial
• Change in real estate values in areas/ communities adjacent to the facility (e.g., land, homes, rental property etc)	Potentially beneficial
• Savings to rate-payers from decreased nuclear fuel costs	Beneficial
• Increase in local employment opportunities	Beneficial
• Impacts to local retail trade and services	Beneficial
• Development of local workforce capabilities	Potentially beneficial
Qualitative Costs	
• Change in real estate values in areas/ communities adjacent to the facility (e.g., land, homes, rental property etc)	Potentially inflationary
• Traffic changes along local streets and highways	Some increases during shift changes
• Demand on local services, public utilities, schools, etc	Some increased utilization expected
• Impact to natural environmental components (e.g., wildlife, water quality, air quality, etc	Minimal impacts
No Impact	
• Alteration of aesthetic, scenic, historic, or archaeological areas or values	No measurable impact
• Change in local recreational potential (e.g., hunting, fishing, camping, etc)	No impact

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8.2 ENVIRONMENTAL BENEFIT/COST FACTORS: SITE PREPARATION, PLANT CONSTRUCTION AND OPERATION

8.2.1 ENVIRONMENTAL BENEFIT/COST FACTORS: SITE PREPARATION AND PLANT CONSTRUCTION

8.2.1.1 Impact on Existing Terrain

There will be minimal disturbance to existing terrain features at the project site associated with construction activities. Only approximately a 70 acre portion of the total 442 acre site will be subjected to clearing and earthmoving activities. Site property terrain outside the primary plant area will be left in its preconstruction condition.

8.2.1.2 Land Conservation and Erosion Control Measures

It is anticipated there will be some short term increases in soil erosion at the site due to construction activities. Erosional impacts due to site clearing and grading will be mitigated by utilization of proper construction and erosion control techniques. Earth berms, dikes and sediment fences will be constructed as necessary during all phases of construction. Cleared areas will be seeded as soon as practical and fugitive dust will be controlled by watering.

8.2.1.3 Aesthetic Impacts and Changes

Visual and noise impacts due to site preparation and plant construction activities are anticipated to be minimal due to the remote location of the site and the buffer zone of vegetation which will be left along the outer perimeter of the property boundary. Some elevated and intermittent noise levels during construction may be observable off-site but should not constitute an annoyance to nearby residences. The visual intrusion of the LES facility upon an otherwise relatively denuded landscape of the plant site property should not be objectionable given the vegetative buffer around the site and its remote location.

8.2.1.4 Impact on Flora and Fauna on Facility Site

Preconstruction and construction activities at the site are not expected to have any significant adverse impact on vegetation and wildlife. Prior to construction of the LES facility, the site was timbered by the previous property owner leaving only a typical clear-cut landscape upon which the plant was to be constructed. It is anticipated that construction activities within the existing clear cut area will remove some shrub vegetation and displace some small animal life from site. No rare or endangered plant or animal species will be impacted by the facilities construction activities.

8.2.1.5 Restoration of Plant and Animal Habitats

No environmental restoration activities within the approximately 70 acre plant facility area will be possible since most areas will be utilized for dedicated operational functions. Areas of the 442 acre site outside the primary facilities area which had been timbered by previous owners will be allowed to revegetate naturally. The decision to allow the site to revegetate naturally rather than institute a reforestation program was made in consultation with Louisiana State Wildlife personnel who believed a natural regrowth sequence would enhance feed for wildlife on the property.

8.2.1.6 Access Roads and Changes to Local Traffic Patterns

Site preparation and construction activities will result in the closure and permanent rerouting of Parish Road #39. No interruption in local traffic patterns is anticipated during the time the road is being rerouted. A short access segment off Parish Road #39 will be constructed onto the site property.

There are no bridges or railway crossings along any access roads to the site which will require removal or upgrading. Little environmental impact is expected due to the need to relocate Parish Road #39. LES has agreed to grant right-of-way leases to the Parish for portions of its property suitable for the roads relocation and will provide some of the engineering expertise and services required to accomplish the reroute.

8.2.1.7 Impact on Water Supply and Quality

Site preparation and construction activities are not expected to adversely impact surface or groundwater supplies within or outside the property boundaries. Runoff impacts to surface water quality will be minimized by appropriate erosion control measures. The low volumes of groundwater that will be utilized for construction activities will not impact groundwater quality or supply.

8.2.1.8 Noise, Pollution, Waste and Dust Control Measures

Objectionable construction noises are to be reduced to acceptable levels by use of noise control equipment on all powered equipment.

Tree lined buffer areas which will be left around the project property will also contribute to noise reduction. Construction debris generated by facility construction activities will be land filled or burned under provisions of permits issued by the state or local authorities.

Wastes such as chemicals, lubricants, bitumens and raw sewage will be handled in accordance with all applicable state and local la . There are no organic wastes, chemicals or fuels which will be posed of on the site.

Liquid effluents from construction activities are drained to pits or settling ponds prior to release. Traffic areas will be watered as necessary to prevent dust. All potential air pollution and dust emission conditions will be monitored to assure compliance with applicable OSHA and environmental regulations.

8.2.1.9 Provisions for Housing and Transportation for Workers and Families

Approximately 15 percent of the peak construction work force of 400 is expected to move into the vicinity as new residents requiring housing. It is anticipated that sufficient housing will be available to accommodate their housing needs. A few new houses and small business facilities may be built in response to construction activities and in anticipation of future industrial growth in the Parish.

Facility construction is expected to cause some increase in traffic along local roads to the site; however, as discussed in Section 4.1.1.2, should not cause any objectionable delays.

8.2.2 ENVIRONMENTAL BENEFITS/COST FACTORS: PLANT OPERATION

8.2.2.1 Chemical Impacts: Surface and Groundwater Quality

No liquid effluents will be discharged to the natural environment at levels above established regulatory standards. Therefore, plant operations will not impair the chemical quality of either surface or groundwaters.

8.2.2.2 Biological Impacts: Terrestrial and Aquatic Environments

Detailed evaluations of facility operations on various biological components (i.e., wildlife, trees, etc.) both on and off-site are presented in Chapter 4. The minimal quantities of liquid plant effluents from all systems will be in compliance with state and federal regulations and thus are not projected to have a measurable impact on either the terrestrial or aquatic environments.

8.2.2.3 Air Quality Impacts

Air emissions from the facility during normal facility operations will be limited to the plant ventilation air systems. All the plant ventilation air is to be filtered and monitored on a continuous basis for chemical and radiological contaminants which could be derived from the uranium hexafluoride process system. If any uranium hexafluoride contaminants are detected in ambient inplant air systems, the air is treated by appropriate filtration methods prior to its venting to the environment. Therefore, no adverse air quality impacts to environmental components either on or off-site are anticipated to occur.

8.2.2.4 Impacts on Aesthetics and Quality of Life

No impairments to local aesthetic values and quality of life will result due to the operation of the LES uranium enrichment plant. The facility and associated structures will be relatively compact, located in a rural location and visually masked from public view by a tree-vegetation buffer. No offensive noise or odors will be produced as a result of plant operations.

It is anticipated the overall quality of life will be enhanced for the local populace due to the economic impact of increased employment opportunities within the Parish.

8.2.2.5 Radiological Impacts

8.2.2.5.1 Surface and Groundwaters

Radionuclides concentration levels in effluent waters from the facility will not exceed regulatory limitations and thus no impacts to either surface or groundwater supplies will result due to plant operations. All in-plant effluents from operational systems which may contain or be exposed to uranium radionuclides will be monitored and treated, if required, to achieve required regulatory release levels.

8.2.2.5.2 Aquatic and Terrestrial Life

It is not anticipated that natural biological components, either on or off-site, will be in contact with or accumulate measurable radionuclide levels due to normal plant operational activities. Projected levels and kinds of radionuclides that may occur in liquid effluents associated with normal plant operations are discussed in Chapter 4. Therefore, based on the deminimus and permissible levels of radionuclides which may be discharged, there will be no impact to aquatic and terrestrial organisms.

8.2.2.5.3 Human Food Chain Impacts

No radiological impacts to human food chain components (e.g., livestock, vegetables, etc.) are projected to occur as a result of normal facility operations. The projection is made based on the fact that all potential radionuclide effluents will be at or below all applicable regulatory requirements that have been established to protect human health.

8.2.2.5.4 Ambient Air

Air emissions from the LES facility will be monitored continuously for radioactivity levels to insure compliance with applicable federal and state regulatory requirements. Projected average annual release rates from the facility during normal operations are presented in Chapter 4. No radionuclides will be released at levels which could be detrimental for human exposures either on or off the site.

8.2.2.6 Facility Heat Dissipation Impacts

As described in Chapter 4 of the ER and Chapter 6 of the SAR, facility waste heat dissipation will be accomplished by air-cooled, closed-loop, water cooling units. Based on the small number and size of all the facilities cooling circuits, no onsite or offsite meteorological changes result, such as fogging or icing.

There will be no heated liquid discharges to the environment from any in-plant systems and therefore no thermal impacts to surface waters will occur.

8.2.2.7 Other Effects of Plant Operation

8.2.2.7.1 Sanitary and Other Waste Discharges

The sanitary waste treatment system for the LES facility is described in Chapter 6, Section 6.4-7 of the SAR. The planned sanitary system will meet all applicable discharge standards prescribed by the Louisiana Department of Environmental Quality. No biological effects of the treated effluent to onsite or offsite receiving waters will result. Overall, the operation of the system will be monitored by a trained operator certified by the state of Louisiana.

Disposition of the small quantities of non-radioactive solid waste materials resulting from normal facility operations, including trash and garbage, will be to an approved offsite landfill. Total annual volumes of facility garbage and other miscellaneous waste materials landfilled offsite is not projected to represent an extraordinary impact to existing landfill capacities.

8.2.2.7.2 Emergency Generator Engine Exhausts

Two 1500 KW, 2170 BHP diesel generator engines at the facility are being provided to supply emergency electrical power in the event of any power interruptions. Each engine consumes 110 gph of number 2 diesel fuel which has a maximum sulfur content of approximately 0.5%. Calculations, assuming that total sulfur content of the fuel will be exhausted to the atmosphere and that nitrous oxides will be released at the rate of 10.7 grams/BHP hour, indicate there will be no health or environmental impacts associated with the short-term operation of these engines.

8.2.2.7.3 Consumptive Water Use

Process water supply for the facility will be withdrawn from an on-site well drawing water from the Sparta Aquifer zone. A description of the various plant systems and their volumetric water use rates are given in Chapter 6, Section 6.4.5 of the SAR. The relatively low annual water use by the facility is not projected to diminish supplies available for use by others in the area.

8.2.2.7.4 Additive/Interactive Impact of Facility Effluents with Other Industrial or Commercial Operations

Effluents from the facility are not expected to measurably impact or environmentally interact with components of other man-induced effluents in any offsite areas. Information regarding other neighboring industrial commercial facilities is presented in Chapter 2, Section 2.2 of the ER. A review of the quantities and types of effluents/emissions from these facilities indicates no potential additive or interactive situation will exist relative to the LES facilities effluents and emissions.

8.2.2.7.5 Increased Knowledge of the Natural Environment from Plant Operations

Air and water quality surveillance activities at the LES facility are expected to provide an additional level of technical knowledge regarding a wide range of environmental conditions at and near the site. Meteorological information (e.g., windspeed and temperature), which will be collected on a continuous basis will provide a broader base of technical data pertinent to the public regarding air quality issues. Surface and groundwater measurements made in effluent and receiving areas will serve to supplement existing knowledge regarding changes in ambient water quality.

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9.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

This chapter provides an assessment of all licenses, permits, certifications, approvals and consultations required for the Louisiana Energy Services uranium enrichment facility for protection of the environment.

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9.1 FEDERAL AGENCIES

The Nuclear Regulatory Commission (NRC)

The Atomic Energy Act of 1954, as amended, gives the NRC regulatory jurisdiction over the design, construction, and operation of the LES facility specifically with regard to the nuclear aspects relating to assurance of public health and safety. Periodic surveillance of construction, operation and maintenance are performed by the Nuclear Regulatory Commission. The environmental impact of the plant is assessed by the NRC in accordance with 10 CFR 51.

Environmental Protection Agency (EPA)

The Federal Water Pollution Control Act Amendments of 1972 created the National Pollutant Discharge Elimination System [NPDES] (Section 402 Public Law No. 92-500, Oct. 18, 1972) authorizing the regional administrator of EPA to issue permits for the discharge of any pollutant, subject to certification from the state having jurisdiction that the discharge effluents are in accordance with all applicable water quality standards. The state of Louisiana has authorization to administer the NPDES program in Louisiana, and presently holds enforcement and compliance responsibility for all NPDES permits issued for facilities operating in Louisiana.

The Clean Water Act of 1977, as amended, requires LES to continue its close working relationship with Region IV - Environmental Protection Agency and the State of Louisiana with regard to future NPDES licensing.

The Clean Air Act of 1970, as amended, authorizes the EPA to ensure that national air quality standards are maintained under state implementation plans for the control of air pollution. The Louisiana plan for implementation of the National Air Quality Standards has been submitted to and approved by the administrator of the EPA. Regulations arising from any new legislation are followed closely by LES since they could affect operation aspects and requirements for the CEC.

U.S. Army Corps of Engineers (U.S. COE)

The Federal Water Pollution Control Act amendments of 1972 (P.L. 92-500) established a permit program under Section 404 to be administered by the Secretary of the Army acting through the Corps of Engineers and regulating the discharge of dredged or fill material into "navigable waters." Prior to 1972, Corps jurisdiction extended only over "navigable waters of the U.S.". This definition with the passage of P.L. 92-500 was administratively defined and broadened to include "the waters of the U.S."

Applications for Section 404 permits are evaluated by using guidelines developed by the Administrator of EPA in conjunction with the Secretary of the Army.

Other Federal Agencies

During the planning and development of the project, LES will continue to cooperate with a number of federal agencies having specific areas of environmental interest and responsibilities. Examples include the Fish and Wildlife Service, the Geological Survey, the Federal Aviation Administration, the Forest Service, and the Soil Conservation Service.

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9.2 STATE AGENCIES

Louisiana Department of Environmental Quality (LADEQ)

The Louisiana Department of Environmental Quality is charged with the responsibility to manage Louisiana's air quality and nuclear energy activities within the state through the Office of Air Quality and Nuclear Energy; solid waste, hazardous waste and underground storage tanks through its Office of Solid and Hazardous Wastes; and surface and groundwaters of the state by the Office of Water Resources. State regulatory controls include the issuance of authorizations and discharge permits, enforcement of permit requirements, and the review and certification of municipal and industrial project activities affecting the state's air and water quality.

Louisiana Department of Public Safety & Corrections

The Louisiana Department of Public Safety & Corrections through the Office of State Police and the Emergency Response Commission has the responsibility to manage and implement state activities regarding the Superfund Amendments and Reauthorization Act (SARA) and "Right-to-Know" laws for all commercial and industrial facilities within the state. Regulations administered by the Department require owners and operators of any facility to notify the Department, the emergency planning committee within the Parish in which the facility is located, and local fire department each year regarding descriptions, hazards, amounts and specific site location of certain categories of chemicals and other substances stored in a facility.

Louisiana Department of Health and Human Resources

The state Department of Health and Human Resources, Office of Preventative and Public Health Service, has regulatory responsibility pertaining to areas of sanitation, vector control and other human health related matters. All design and specifications for sanitary treatment plants and systems must be approved by the Department to assure compliance with applicable and acceptable treatment capacities and standards.

Louisiana Department of Transportation and Development

The Louisiana Department of Transportation and Development, Office of Highways, is charged with reviewing and approving all planned automotive access roads to and from the state roadway system. In addition, the department, through its Office of Engineering and Dam Safety has responsibility for review, approval and inspection of any structures engineered to impound waters of the state.

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9.3 LOCAL AGENCIES

Plans for construction and operation of the proposed LES facility are being communicated to and coordinated with local organizations such as the Claiborne Parish Police Jury and community officials regarding relocations of roads and water lines which traverse the site, the Parish Health Department personnel regarding approvals for the LES sewage system components and utilization of landfills, and with the Lisbon Volunteer Fire Department and the Parish Emergency Planning Committee regarding SARA and Right-to-Know requirements and regulations.

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9.4 STATUS OF FEDERAL, STATE, AND LOCAL PERMITS/AUTHORIZATIONS

The construction and operation of the LES uranium enrichment facility in Claiborne Parish, Louisiana requires the procurement of numerous federal, state, and local licenses, permits and certifications/authorizations. Table 1 lists the various permits and authorizations required and their status.

Table 9.4-1 (Page 1 of 3)
LES Claiborne Enrichment Center
Federal, State and Local Authorizations

Agency	Activity/Authorization	Date of Issue or Initiation	Status
Federal:			
Nuclear Regulatory Commission (NRC)	Construction and Operating License	Jan 31, 1991	Application Filed
U.S. Environmental Protection Agency (EPA)	NPDES Discharge Permit Authorization to construct and discharge wastewaters		Application Being Prepared
U.S. Army Corps of Engineers (COE)	Construction Activities in Wetlands area dredge/fill permit		Need for Permit Under Review
State:			
Louisiana Dept of Environmental Quality (LADEQ)	Wastewater discharge permit for treated sanitary and process system effluents		Application Being Prepared
Louisiana Dept of Environmental Quality (LADEQ)	Approval and permit for air emissions from facility		Application Being Prepared
Louisiana Dept of Environmental Quality (LADEQ)	Review/approval and permit for water supply well and water distribution system		Application Being Prepared
Louisiana Dept of Environmental Quality (LADEQ)	Notification and registration of fuel oil storage tanks		Application Being Prepared

Table 9.4-1 (Page 2 of 3)
LES Claiborne Enrichment Center
Federal, State and Local Authorizations

Agency	Activity/Authorization	Date of Issue or Initiation	Status
Louisiana Dept of Environmental Quality (LADEQ)	Review and approval to construct and operate groundwater monitoring well		Application * Being Prepared
Louisiana Dept of Environmental Quality (LADEQ)	License and permit to receive, handle and store radioactive materials		Application Being Prepared
Louisiana Dept of Environmental Quality (LADEQ)	License to store hazardous "mixed waste" materials (i.e., TSDF Permit)		Need For Permit Under Review
Louisiana Dept of Environmental Quality (LADEQ)	Interim storage permit for hazardous waste material		Application Being Prepared
Louisiana Dept of Transportation and Development	Approval of plans/specifications to access state roadways		Application Being Prepared
Louisiana Dept of Transportation and Development	Safety review and approval of existing earthen dam structures		Application Being Prepared
Louisiana Dept of Public Safety and Corrections	Approval of plans/specifications for construction of LES buildings and auxiliary facilities (building permits)		Application Being Prepared

* LADEQ authorization for LES contractors to install seven groundwater wells on CEC site to assess "baseline" conditions was sought in May 1990 and authorization was received in June 1990.

Table 9.4-1 (Page 3 of 3)
LES Claiborne Enrichment Center
Federal, State and Local Authorizations

Agency	Activity/Authorization	Date of Issue or Initiation	Status
Local:			
Claiborne Parish Health Department	Authorization to utilize sanitary landfill		Authorization To Be Sought
Claiborne Parish Health Department	Authorization to utilize existing construction landfill capacity or create on-site construction landfill area.		Need for Authorization To Be Reviewed

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9.5 PUBLIC PARTICIPATION - INFORMATION MEETINGS

LES has conducted an active public information program to inform and solicit ideas and comments from the public, particularly the citizens of Claiborne Parish and the surrounding areas near the LES uranium enrichment facility site. In all public meetings held, LES presented an orientation of the project in which long-range plans and general philosophy on building and operating the uranium enrichment facility were discussed.

Information meetings and activities have been held starting June 8, 1989, through November 1990 at various locations throughout the Parish and elsewhere. Subsection 9.5.1 lists the dates of the major meetings, significant topics discussed, and a general description of the attending group at the meetings.

9.5.1 LIST OF MEETINGS

** June 8, 1989

Homer National Bank

Topics discussed:

(1) Purpose of uranium enrichment
(2) Centrifuge technology
(3) Safety management regarding radiation, uranium hexafluoride, storage of depleted uranium
(4) Selection of Claiborne Parish
(5) LES as an equal employment opportunity employer

Attendees:

Joe Michael, Mayor, town of Homer

Jim Oakes, administrative assistant to U.S. Senator Bennett Johnson

Pete Pearson, president, Homer Industrial Foundation

Dr. Nelson Philpot, director, Hill Farm Research Station - Louisiana State University

J.T. Taylor, president, Claiborne Parish Industrial Development Foundation

Travis Tinsley, chairman, Contact Committee, Claiborne Parish Industrial Development Foundation

** June 9, 1989

Office of Economic Development, State of Louisiana, Baton Rouge

Topics discussed:

(1) Louisiana Energy Services' proposed uranium enrichment facility to be sited in Claiborne Parish

(2) Economic and environmental benefits of the proposed facility

Attendees:

Arnold Lincove,
Harold Price

Office of the Governor, Baton Rouge

Topics discussed:

(1) LES uranium enrichment facility

(2) Environmental and economic benefits

Attendees:

The Honorable Buddy Roemer, governor of Louisiana

P.J. Mills, the governor's chief of staff

News Conference, Shreveport Chamber of Commerce

Topics discussed:

(1) Fuel cycle, including uranium enrichment

(2) Centrifuge technology

(3) Economic impact

Attendees:

News media representatives from Shreveport, Claiborne Parish, Bienville Parish, Ruston, Monroe.

Courthouse Square, Claiborne Parish

Topics discussed:

(1) Centrifuge enrichment facility

(2) Economic and environmental benefits

Attendees:

300-400 hundred citizens of Claiborne Parish

** June 15, 1989

Department of Environmental Quality, Baton Rouge

Topics discussed:

(1) How a centrifuge enrichment facility works

(2) DEQ organization and process

Attendees:

James Friloux, Office of Local Programs and Public Participation, Dept. of Environmental Quality;

Billy Wilton, Office of Economic Development

** Week of June 26, 1989

30 meetings were held throughout Claiborne Pairsh, with more than 1000 attendees. These meetings were held in various locations, Haynesville, Athens, Lisbon and Junction City.

Topics discussed:

(1) Nuclear fuel cycle, including enrichment

(2) Purpose of proposed LES uranium enrichment facility

(3) Showing of slides of Urenco's European enrichment facilities

(4) Showing of videotape regarding announcement of selection of Claiborne Parish for LES facility and explaining how the centrifuge process works

(5) Safety management

(6) Economic benefits

Attendees:

Attendees included the police jurors and staff; city council members; city and parish employees; chamber of commerce boards and superintendents, principals and staff; Vo-Tech school representatives; housing authority and staff; warden and staff; Louisiana Power and Light, Arkansas Power and Light, co-op and municipal electric system management and staff; civic organizations, including Lions, homemakers clubs, garden clubs, music clubs and AARP; church pastors, staffs and circles; newspaper editors and reports.

** Week of June 26, 1989

Meeting was held with two residents - Ronnie Anderson and Toney Johnson - who had expressed opposition to the project.

** June 27, 1989

Haynesville - Fair Building; three separate meetings were held

Topics discussed:

(1) Description of plant, purpose of uranium enrichment

(2) History of project

(3) Selection of Claiborne Parish

(4) Nuclear fuel cycle

(5) Environmental and safety studies to be done

(6) Desire for local employees

(7) Storage of depleted uranium; marketing potential for this material

(8) Types of employment during construction and operation

Attendees:

Approximately 80 citizens of Claiborne Parish were present at the most heavily attended meeting.

Former Claiborne Bank Building

Topics discussed:

(1) Description of plant, purpose of uranium enrichment

(2) History of project

(3) Selection of Claiborne Parish

(4) Nuclear fuel cycle

(5) Environmental and safety studies to be done

(6) Desire for local employees

(7) Storage of depleted uranium; marketing potential for this material

(8) Types of employment during construction and operation

Attendees:

Citizens of Claiborne Parish

Haynesville Lions Club, Ladies Night, Haynesville Country Club

Topics discussed:
(1) LES uranium enrichment facility; purpose and how it works

(2) Selection of North Louisiana, Claiborne Parish

Attendees:

Lions Club members and spouses

** June 28, 1989

Linder Motor Lodge

Topics discussed:

(1) Nuclear fuel cycle
(2) How the centrifuge process works
(3) Environmental and economic benefits

Attendees:

Approximately 13 female residents of Claiborne Parish

** June 29, 1989

Homer - Meetings were held at City Hall, School Board office, Library, Homer Memorial Hospital, Ford Museum/Chamber of Commerce, Linder Motor Lodge

Topics discussed:

(1) Description of plant, purpose of uranium enrichment

(2) History of project

(3) Selection of Claiborne Parish

(4) Nuclear fuel cycle

(5) Environmental and safety studies to be done

(6) Desire for local employees

(7) Storage of depleted uranium; marketing potential for this material

(8) Types of employment during construction and operation

Attendees:

Approximately 60 citizens of Claiborne Parish attended the meeting at Linder Motor Lodge, with smaller numbers at other meetings.

** July 31, 1989

Tall Timbers Lodge; the two meetings listed below were held in response to citizens' questions raised as a result of misleading information disseminated by a national anti-nuclear group.

Topics discussed:

(1) How the centrifuge process works

(2) How this process differs from gaseous diffusion

(3) Safety features of centrifuge process

(4) Integrity of storage cylinders

Attendees:

Board of Directors, Claiborne Parish Industrial Development Foundation

Tall Timbers Lodge

Topics discussed:

(1) How the centrifuge process works

(2) How this process differs from gaseous diffusion

(3) Safety features of centrifuge process

(4) Integrity of storage cylinders

Attendees:

Approximately 15 residents of Claiborne Parish and surrounding area.

** August 1, 1989

Homer - Ford Museum and one other location

Topics discussed:

(1) Safety measures at LES uranium enrichment facility

(2) Storage of depleted uranium; integrity of cylinders

(3) How the centrifuge process works

(4) Urenco's experience with decommissioning

(5) Planning and funding for decommissioning the LES facility

Attendees:
15 citizens at Ford Museum; unknown number at other location.

** August 1, 1989
Monroe - Monroe Lions Club

Topics discussed:

(1) Description of plant, purpose of uranium enrichment
(2) History of project
(3) Selection of Claiborne Parish
(4) Nuclear fuel cycle
(5) Economic benefits

Attendees:
100 members

** August 24, 1989

Homer - Homer National Bank News Conference

Topics discussed:

(1) LES organization structure and naming of W. Howard Arnold as president

(2) status of project, including licensing/permitting requirements of U. S. Nuclear Regulatory Commission, LA Dept. of Environmental Quality

(3) Future local employment opportunities

Attendees:

Reporters from Claiborne Parish newspapers, Shreveport Times

Homer National Bank; this meeting was held in response to questions about cylinder safety by the local fire chief.

Topics discussed:

(1) Emergency planning

(2) Integrity of shipping/storage cylinders

(3) Showing of videotape "UF6-It's Some of Your Business"

Attendee:

Dennis Butcher, Chief, Homer Fire Dept.

** September 8, 1989

Louisiana Industrial Development Executives Association, Ruston

Topics discussed:

(1) LES uranium enrichment facility

(2) Economic and environmental benefits

Attendees:

25 industrial development executives

** September 9, 1989

Homer Public Library

Topics discussed:

(1) LES uranium enrichment facility

(2) Safety management regarding radiation, uranium hexafluoride, storage of depleted uranium

Attendees:

Approximately 35 members of Delta Kappa Gamma, an honorary teachers organization.

** November 2, 1989

Tall Timbers Lodge

Topics discussed:

(1) Selection of site for LES uranium enrichment facility

Attendees:

Approximately 20 elected officials, business leaders, parish industrial development officials.

** November 3, 1989

To personally convey information about selection of site in Claiborne Parish, personal visits were made to various plant site neighbors.

Topics discussed:

(1) Selection of site for LES uranium enrichment facility

(2) Nuclear fuel cycle - where enrichment fits in

(3) Safety management regarding radiation, uranium hexafluoride, storage of depleted uranium

(4) Future rerouting of Parish Road 39

People visited:

Mr. and Mrs. William Benson, Forest Grove Rd.
Dorothy Hamilton, Elmer Kidd Rd.
Mrs. Elmer Kidd, Elmer Kidd Rd.
Maureen Wafer and Ada Mitchell, Elmer Kidd Rd.
Rick Minifee, Elmer Kidd Rd.
Clifton Battles, Forest Grove Rd.
C. Sims, Forest Grove Rd.
Fredrick Lowery, Forest Grove Rd.
Phil Malone, Forest Grove Rd.
Chick Ellis, Arizona General Store, Hwy. 2

A letter announcing the site selection was left at residences of approximately five site neighbors who were not at home when personal visits were attempted:

Mr. and Mrs. William Ferguson, Elmer Kidd Rd.
Ardis James, Elmer Kidd Rd.
Frank Turner, Elmer Kidd Rd.
Mr. and Mrs. Arthur Williams, Elmer Kidd Rd.
John Lee Willis, Elmer Kidd Rd.

** November 3, 1989

<u>News conference, Homer National Bank</u>

Topics discussed:

(1) Selection of site for LES uranium enrichment facility

Attendees:

Guardian Journal (Homer), Haynesville News, Shreveport Times

** November 30, 1989

Minden Lions Club, Minden, LA

Topics discussed:

(1) Nuclear fuel cycle - where enrichment fits in

(2) How a centrifuge enrichment facility works

Attendees:

Approximately 50 members of the Lions Club

Home of Mr. and Mrs. Ray Malone, Claiborne Parish

This meeting was held in response to a request by Mrs. Malone.

Topics discussed:

(1) Nuclear fuel cycle - where enrichment fits in

(2) How a centrifuge enrichment facility works

(3) Safety issues - radiation, uranium hexafluoride, storage of depleted uranium

(4) Proposed licensing legislation

Attendees:

Mrs. Ray Malone, Ms. Essie Youngblood, Ms. Margie Walker, Ms. Emma Hilliard

** December 14, 1989

Center Springs CME Church, Claiborne Parish

Topics discussed:

(1) How the LES centrifuge enrichment facility works

(2) Safety measures - including managing radiological and chemical risks, safe storage of depleted uranium

(3) Economic impact

Attendees:

Approximately 100 citizens of Claiborne Parish
This meeting was held in response to a request by Ms. Essie Youngblood taken during Nov. 30 meeting at Mrs. Malone's

** January 10, 1990

Ruston Rotary Club - Holiday Inn, Ruston

Topics discussed:

(1) LES uranium enrichment facility

(2) Economic and environmental benefits

Attendees:

Approximately 70 Rotarians and news media from Ruston and Monroe.

** January 10, 1990

Home of Norton Tompkins, Airport Rd., Claiborne Parish; this meeting was held in response to questions by several Claiborne Parish citizens.

Topics discussed:

(1) LES partners

(2) Tax revenues

(3) Disposition of depleted uranium

(4) Environmental issues

Attendees:

Bynum Blackmon
Bob Brakefield
Lewis Nelson
H. Rushing
A C Stockinger
Norton Tompkins
Buck Tuggle

Emerson Oil Co., Homer; this meeting was held in response to a request by a plant site neighbor.

Topics discussed:

(1) How the LES uranium enrichment facility works; its place in the nuclear fuel cycle

(2) Safety measures at LES plant; including management of relative radiological and chemical risks and safe storage of depleted uranium

Attendees:

Approximately 35 plant site neighbors and other citizens of Claiborne Parish; Homer Guardian-Journal

** January 11, 1990

Ruston Economic Development Group, Holiday Inn - Ruston

(1) LES enrichment facility

(2) Economic and environmental benefits

Attendees:

Approximately 35 civic and business leaders

** February 8, 1990

Homer High School

Topics discussed:

(1) Purpose of uranium enrichment

(2) Nuclear fuel cycle

(3) Basic radiation information

(4) Safety measures of proposed LES plant; including management of relative radiological and chemical risks and safe storage of depleted uranium

Attendees:

Approximately 350 Claiborne Parish residents; news media from Claiborne Parish, Shreveport, Monroe

** February 13, 1990

Louisiana Engineering Society, Annual Meeting

Topics discussed:

(1) Nuclear fuel cycle

(2) LES uranium enrichment facility

Attendees:

Approximately 60 engineers and their guests

** February 22, 199

Homer Lions Club

Topics discussed:

(1) Use of nuclear power in U.S.

(2) Growth in energy demand

(3) Type of economic development around Duke Power's nuclear stations

Attendees:

Approximately 35 Lions Club members

Haynesville Chamber of Commerce Annual Banquet, Fair Building

Topics discussed:

(1) Use of nuclear power in U.S.

(2) Growth in energy demand

(3) Type of economic development around Duke Power's nuclear stations

Attendees:

Approximately 180 citizens of Claiborne Parish

** April 5, 1990

El Dorado (Ark) Chamber of Commerce

Topics discussed:

(1) Nuclear fuel cycle

(2) How the LES uranium enrichment facility will work

Attendees:
Approximately 25 El Dorado business and civic leaders

American Institute of Chemical Engineers, El Dorado, Ark.

Topics discussed:

(1) Nuclear fuel cycle

(2) How the LES uranium enrichment facility will work

Attendees:

Approximately 40 members of the local chapter

** April 26, 1990

Appreciation Dinner, Fair Building, Haynesville

Topics discussed:

(1) Announcement of LES partnership agreement

Attendees:

Approximately 350 citizens of Claiborne Parish; Shreveport Times; Haynesville News; Guardian-Journal

** April 27, 1990

News conference, Homer National Bank

Topics discussed:

(1) Naming of plant

(2) LES partnership agreement

(3) Project status

(4) List of goods, services that LES hopes to obtain from Louisiana suppliers, with special efforts to reach minority-owned businesses

Attendees:

Claiborne Parish newspapers

Homer National Bank

Topics discussed:

(1) Plant safety issues

Attendees:

Toney Johnson
Norton Tompkins
W. Weiland

** April 28, 1990

Louisiana State University - Shreveport

Topics discussed:

(1) Nuclear fuel cycle

(2) Plant safety

Attendees:

Approximately 80 residents of Claiborne Parish and other interested citizens

** May 7 and 8, 1990

Urenco enrichment facilities in Gronau, W. Germany and Almelo, The Netherlands

LES sponsored a tour for Claiborne Parish residents to obtain first-hand information about Urenco's European enrichment facilities. This tour included presentations by plant officials, visiting all major areas of the plants (including the depleted uranium storage area at Almelo) and opportunities to meet and interview local residents not associated with the plants, both in structured and unstructured settings. Subjects discussed included:

(1) Nuclear fuel cycle

(2) How the Gronau and Almelo plants work (plant tours)

(3) Safety issues and record

(4) Environmental issues and record

(5) Personnel issues (education, pay)

(6) Commitment to and involvement with the local residents and community

Attendees included:

Sherman Brown, supervisor, Claiborne Parish School System
Renford "Chick" Ellis, owner of a general store near the LES plant site
Rev. Howard "Flash" Gordon, minister of the First Presbyterian Church in Homer and president of the Homer Chamber of Commerce
Blake Hemphill, administrative director of the Claiborne Parish Industrial Development Foundation and LES' local representative
Emma Hilliard, police juror in the ward where the LES plant site is located
Dr. Nelson Philpot, resident director, Hill Farm Research Station of Louisiana State University
Jerry Pye, editor, Haynesville News
Ronald Wafer, shift captain, Wade Correctional Center and neighbor of proposed LES plant site

** June 4, 1990

American Nuclear Society, Holiday Inn, Gonzales, LA.

Topics discussed:

(1) Nuclear fuel cycle

(2) How the LES facility will work

(3) Safety, environmental issues

(4) Employment opportunities

Attendees:

Approximately 20 members of the LA chapter

** June 25, 1990

James Street Recreation Center, Ruston

Topics discussed included:

(1) Expected life of LES plant

(2) Viability of nuclear power

(3) How the LES plant will operate

(4) Storage of depleted uranium

(5) Decontamination and decommissioning

(6) Partnership agreement

(7) Employment opportunities

Attendees:

Approximately 25 residents of Claiborne Parish and Ruston

** June 28, 1990

Louisiana State Police, Transportation and Environmental Safety Section, Monroe

Topics discussed:

(1) Purpose of proposed uranium enrichment facility

(2) Uranium hexafluoride (showed videotape of "UF6 - It's Some of Your Business")

(3) Transportation requirements

(4) Design of containers

Attendees:

Lt. Shelton Coleman and one other representative of the state police

** July 18, 19, 1990

<u>Westinghouse Nuclear Fuel Division, Columbia, SC and Oconee Nuclear Station, Oconee County, SC</u>

LES sponsored tours of the above-named facilities to provide information on the portions of the nuclear fuel cycle following enrichment-fuel fabrication and use of fuel in a commercial reactor. The purpose of the tour was to assist in putting the proposed enrichment facility in perspective in terms of relative risk and to allow participants the opportunity to question employees at both facilities and, in the area surrounding Oconee Nuclear Station, to meet local residents both in structured and non-structured settings, to obtain first-hand information on what it is like to have a nuclear facility nearby.

Topics discussed included:

(1) How uranium hexafluoride is transported and temporarily stored

(2) How nuclear fuel is made from enriched uranium hexafluoride

(3) Quality control in fabricating fuel pellets, rods and assemblies

(4) Working conditions, employee health and safety, and length of employment

(5) How a nuclear power plant works

(6) Environmental monitoring around nuclear related facilities

(7) Status of LES project

In the Oconee-Pickens County area, attendees visited with emergency preparedness officials, economic development officials, a high school principal, owner of a machine tool business, radio station owner who was also a county council member, and a hospital emergency room nursing supervisor. The purpose was to assess the social, civic, economic and safety impact of having a nuclear facility as a neighbor.

Attendees included:

Name	Description
Lenora Birch	Member, Claiborne Parish Health Care Committee, and plant site neighbor
Dennis Butcher	Fire Chief, Town of Homer
Chuck Clawson	President, Haynesville Chamber of Commerce
Annie Cooper	Special education teacher
Tom Crocker	Mayor, Town of Haynesville
Judy Davis	Owner-Mgr., Tall Timbers Lodge & member, parish school board
Carol Jiles	Librarian
Ray Killgore	Owner, Sear's catalog store
J.R. McClung	Senior Vice-President, Homer National Bank
Joe Michael	Mayor, Town of Homer
J.R. Oakes	Sheriff, Claiborne Parish
Robert Paulovich	Justice of Peace, Claiborne Parish
Murray Powell	Retired school bus driver and greeter at WalMart
Joe Richardson	Plant site neighbor and retired school system superintendent
Dorris Robinson	Resident, Lake Claiborne
Yvonne Suggs	Secretary, Claiborne Parish Industrial Development Foundation
Don Terry	Owner, The Landmark clothing store
Sherry Whitman	Branch Mgr. - Planter's Bank
Mary Woodall	Chair, Industrial Development Foundation Committee on Retirement & Real Estate
Rev. W.J. Young	Preacher

** July 15 - 20, 1989

<u>Western Carolina University, Sylva, NC</u>

Two science teachers from Claiborne Parish attended Duke Power Co.'s teachers' workshop entitled, "Energy, the Environment and Economics." In addition to classroom presentations on basic electricity, fuel sources, utility regulation and environmental ethics, participants toured a nuclear station, coal-fired station and a hydroelectric station.

Attendees:

Gladys Harris of Homer Junior High School
Martha Harson of Haynesville High School

** August 14 and 15, 1990

Duke Power's Applied Science Center and McGuire Nuclear Station, Lake Norman, NC.

LES sponsored a tour of Duke's environmental laboratories so participants could learn about the comprehensive environmental data gathering and monitoring that are being done for the LES plant. Because this is an effort similar to that done for nuclear power plants, participants were invited to tour Duke's environmental laboratories, which are certified by Environmental Protection Agency protocol and by the states of North Carolina and South Carolina. During the nuclear plant tour, participants learned how the plant works in order to put the purpose of the proposed uranium enrichment facility in perspective.

Attendees:
Peggy Pike, a science teacher from Claiborne Parish
Leslie Johnson, game biologist with the LA. Dept. of Wildlife and Fisheries.

** August 20 and 21, 1990

Urenco enrichment facilities in Gronau, and Almelo, The Netherlands W. Germany

LES sponsored a tour for Claiborne Parish residents to obtain first-hand information about Urenco's European enrichment facilities. This tour included presentations by plant officials, visiting all major areas of the plants (including the depleted uranium storage area at Almelo) and opportunities to meet and interview local residents not associated with the plants, both in structured and unstructured settings. Subjects discussed included:

(1) Nuclear fuel cycle

(2) How the Gronau and Almelo plants work (plant tours)

(3) Safety issues and record

(4) Environmental issues and record

(5) Personnel issues (education, pay)

(6) Commitment to and involvement with the local residents and community

Attendees included:

Donald Haynes, physician
Geraldine Hightower, editor, Guardian-Journal
Alphonse Jackson, Shreveport, elected official in the LA. House of Representatives, and ex-officio member, Claiborne Parish Health Care Committee
Kennedy Morelock, retired editor, Haynesville News
Elizabeth Palmer, schoolteacher
Ruthie Rhodes, supervisor, Claiborne Parish School System, and LES plant site neighbor
Gordon Simmons, service station owner/operator
Travis Tinsley, businessman and chairman of the Contact Committee, Claiborne Parish Industrial Development Foundation
A.D. Williams, director, Haynesville Housing Authority

** June 25 - August 3, 1990

Contracted for college student Theo Eddins of Claiborne Parish to work under the direction of Dr. Ron Thompson of Louisiana Tech Nuclear Center to become familiar with scientific sampling laboratory techniques and basic radiation.

** September 1990

Homer, LA,518 E. Main St., Claiborne Parish

LES opened a centrally located information office in order to provide continuing educational and informational opportunities to parish residents and others interested in the project.

** Novermber 7-11, 1990

Homer - LES Information Office, 518 E. Main St.

LES sponsored evening and weekend "open-house" activities for parish residents and others to view and learn from exhibits on the fuel cycle, Urenco's European enrichment facilities and on jobs available during construction and operation of the CEC. Approximately 200 people attended.

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10.0 REFERENCES

References to sources of information used in preparation of the Environmental Report are located at the end of the text in the section in which they are cited.