TERA

MEETING SUMMARY FEB 22 1979

Docket File
NRC PDR
Local PDR
TIC
NRR Reading
LWR #4 File
E. Case
D. Bunch
R. Boyd
D. Ross
D. Vassallo
W. Gammill
J. Stolz
R. Baer
O. Parr
S. Varga
C. Heltemes
L. Crocker
D. Crutchfield
F. Williams
R. Mattson
R. DeYoung
Project Manager: D. Hood
Attorney, ELD
M. Service
ACRS (16)
R. Denise
L. Rubenstein
NRC Participants: S. Salah
J. Mazetis
S. Newberry
L. Kopp
H. Richings
L. Porse
P. Matthews
V. Benaroya
R. Kirkwood
W. LeFave
D. Pickett
B. Cox

(NO TERA SENT)

7903080157 A

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 22 1979

Docket Nos: 50-329
50-330

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: SUMMARY OF MEETING ON MIDLAND PLANT, UNITS 1 AND 2 CONCERNING CASK DROP, CONTAINMENT SUMP MODEL TESTS, AND STEAM LINE BREAK ANALYTICAL TECHNIQUES

On January 16, 1978, the NRC staff met in Bethesda, Maryland with members of Consumers Power Company (CPCO), Bechtel Associates, Babcock & Wilcox Company, Western Canada Hydraulic Laboratories Ltd., and Ederer Incorporated. Attendees are listed in Enclosure 1. Handouts and viewgraphs used during the meeting are shown as Enclosure 2. The meeting agenda included three items relative to the NRC staff's safety review of Midland Plant Units 1 and 2:

1. Revised Steam Line Break Analytical Codes and Analysis

By several related requests for additional information (i.e., 222.1, 211.166, 211.168, 211.169 and 211.171), the NRC staff had informed CPCO that, to be acceptable, the analyses for a postulated main steam line rupture accident must be revised to consider the effects of an assumed stuck control rod assembly on the power distributions. CPCO stated that these revised analyses would require the development and application of a new computer code, BWKIN, by Babcock & Wilcox. BWKIN will be a multi-dimensional core kinetics code with neutronic and thermal-hydraulic coupling, similar to the MEKIN code developed by Massachusetts Institute of Technology and Battelle Laboratories. Like COBRA, the BWKIN model will permit cross flow between fuel channels. The BWKIN code will utilize the PDQ code for steady-state initial conditions and scoping studies of BWKIN-PDQ will be performed. Transient analyses with the BWKIN code will utilize the TRAP-2 and RADAR codes.

B&W stated that the revised steam line break analyses for Midland are not expected to result in DNB, even during return to power, and that at worst, if DNB should occur, it will be brief and of limited extent such that no DNB propagation would occur. B&W's statement is based upon studies performed on a similar plant, Three Mile Island Unit 3. The worst case for Midland would occur for a full break opening during beginning of life (BOL) conditions when the core is at full power. During BOL, the highest power peaking during steady state conditions occurs at the stuck rod location. The stuck rod has its maximum worth at BOL. At end of life conditions, the highest peak does not correspond to the stuck rod location, but its magnitude is much lower than a BOL peak.

The applicants schedule is based upon a start date of February 1, 1979. Steady-state analyses with BWKIN and PDQ will have been performed by June 1, 1979. The transient and DNBR computations will have been performed by October 15, 1979 and documentation of analyses results will be submitted to the NRC staff by the end of 1979. The description of the BWKIN code will be included as an appendix to a B&W topical report on rod ejection analyses to be submitted in early 1980.

The staff suggested that a further meeting on this effort would be appropriate about June 1, 1979.

2. Spent Fuel Cask Crane

In response to several staff requests for additional information (i.e., 010.10, 010.22, 010.46, 010.57) in which the staff required that the spent fuel cask be prevented from dropping and tipping into the spent fuel pool, CPCO replied that a single-failure proof main hoisting mechanism is being incorporated into the auxiliary building crane. The design is based upon a topical report submitted by Ederer, Incorporated on January 15, 1979. The topical report EDR-1 is entitled "Ederer's Nuclear Safety Related Extra-Safety and Monitoring (X-SAM) Cranes." The report discusses conformance of the design to regulatory guide 1.104 and involves exceptions to the guides positions relative to single hooks and factor of safety on the wire rope. CPCO stated that related information relative to other Midland specific design parameters will be further addressed by FSAR amendment in April, 1979. CPCO also stated that the fuel pool area crash pads and spent fuel cask transfer carriage in the existing design will be deleted because these components are no longer needed with the revised design.

3. Containment Sump Model Tests

CPCO advised that hydraulic model studies will be performed with a full scale model of the Midland containment sump design in order to assess vortex formation and to determine the trashrack and intake losses. The tests are described in the attached proposal by Western Canada Hydraulic Laboratories, Ltd.

CPCO plans to start the physical setup for the tests about March 1, 1979. Actual testing would be conducted throughout May 1979 and a full report is planned in July 1979. The applicant's consultant stated that turning vanes have been successfully demonstrated by tests for previous plants and in their opinion, need not be repeated on Midland; if turning vanes are included, this would add about two weeks to the schedule.

CPCO requested NRC staff comments on the attached test proposal. The staff will comment by mid-February 1979.

Darl Hood

Darl S. Hood, Project Manager
Light Water Reactors Branch No. 4
Division of Project Management

Enclosures:
1. Attendees List
2. Handouts and Viewgraphs

Consumers Power Company

ccs:

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Secretary
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Grant J. Merritt, Esq.
Thompson, Nielsen, Klaverkamp & James
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Minneapolis, Minnesota 55402

Mr. S. H. Howell
Vice President
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Enclosure 1

Attendees

January 16, 1978

D. Hood	DPM
R. Vosburgh	B&W
M. Sakrno	CPCO
G. Hanson	B&W
J. Howard	B&W
R. Reed	B&W
S. Salah	NRC
S. Bian	B&W
J. Zabritski	CPCO
J. Mazetis	NRC
S. Newberry	NRC
L. Kopp	NRC
H. Richings	NRC
R. Hollocon	EDERER
L. Porse	NRC
P. Matthews	NRC
V. Benaroya	NRC
R. Kirkwood	NRC
W. LeFave	NRC
D. Pickett	NRC
B. Cox	NRC
D. Hollingshead	Bechtel
M. Rothwell	Bechtel
D. Hay	Kieiter Canada Hydraulic Labs
R. Elder	Bechtel
M. Pratt	Bechtel

STEAM LINE BREAK WITH TRANSIENT PEAKING

INTRODUCTION AND BACKGROUND

GENERAL ANALYTICAL APPROACH

BWKIN CODE DESCRIPTION

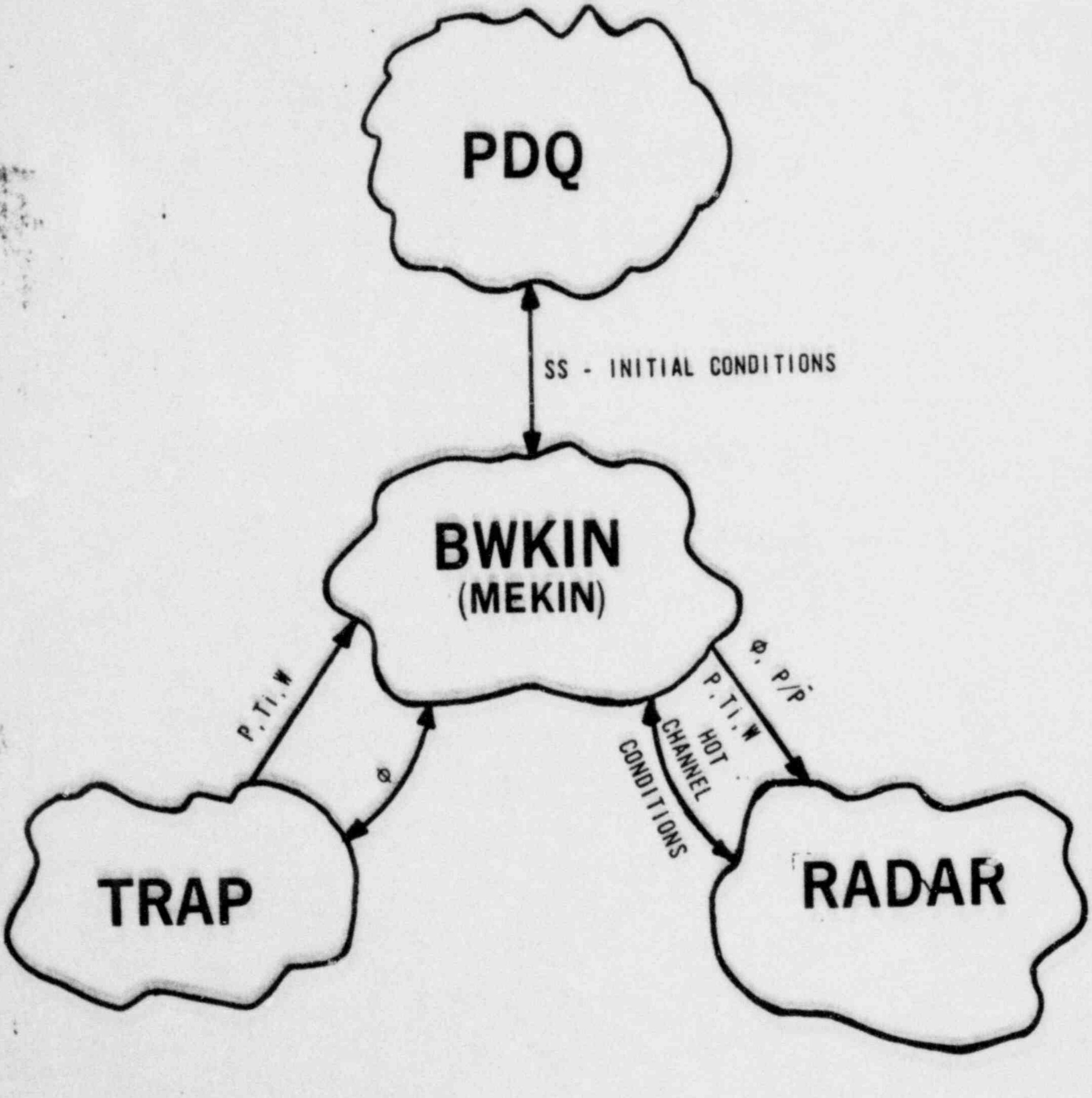
ANALYSIS

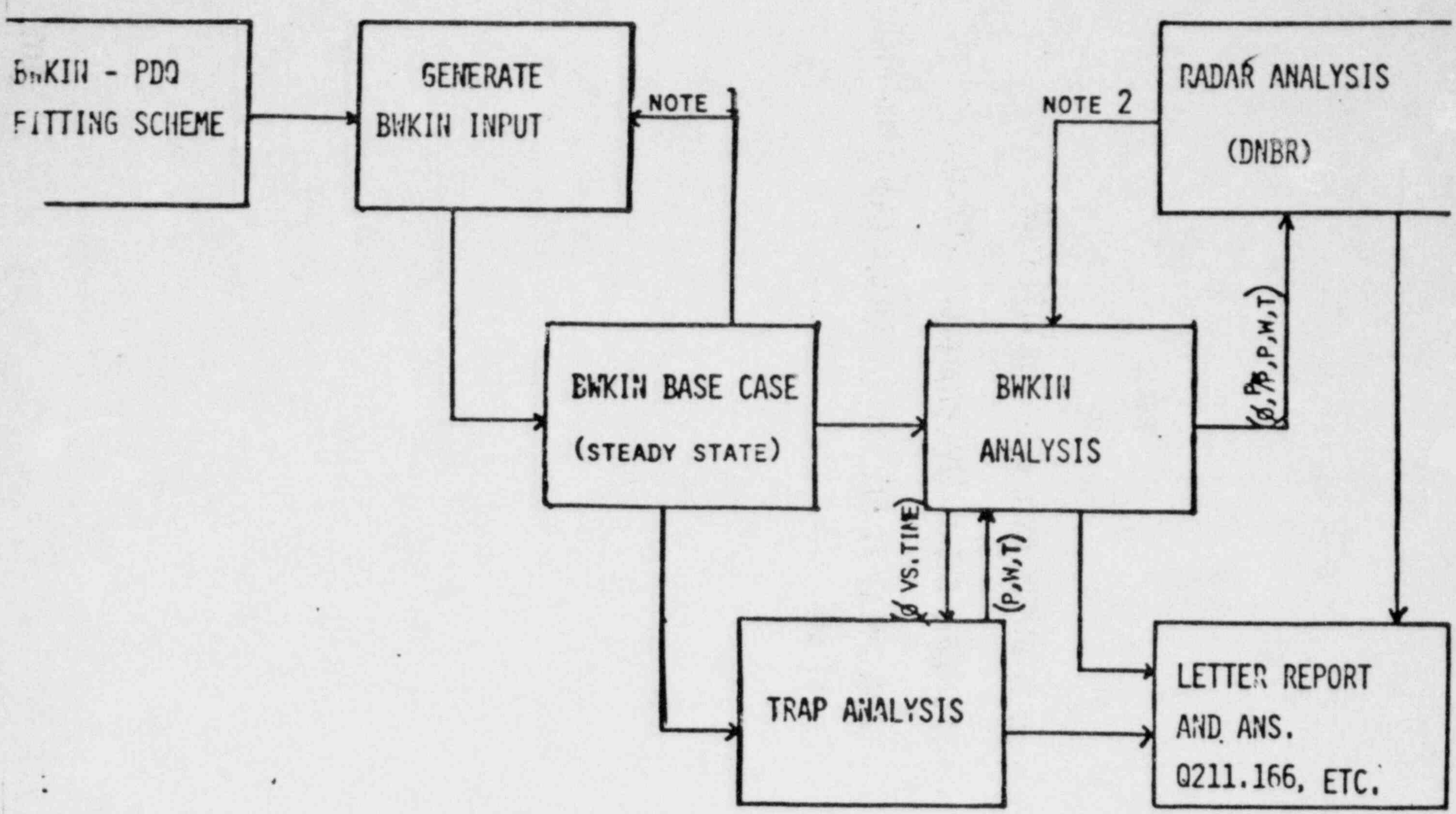
- -INPUT
- -STEADY STATE
- -TRANSIENT
- -DNBR

NRC COMMENT ON PROPOSED RESPONSE

SCHEDULE IMPACT ON CPCO SER/OL

Analysis Code Interfaces





NOTE 1: NORMALIZATION OF BWKIN POWER DISTRIBUTIONS WITH PDQ

NOTE 2: VERIFICATION OF HOT CHANNEL CONDITIONS WITH BWKIN

BWKIN

- MULTI-DIMENSIONAL CORE KINETICS CODE
- NEUTRONIC AND THERMAL-HYDRAULIC COUPLING
- DEVELOPMENT BY MIT (WITH BATTELLE LAB), MODIFIED BY B&W

- I am talking about the statistical average

STEADY STATE BWKIN SET-UP

- NEUTRONIC INPUT - FUEL COMPOSITION, CONTROL ROD PATTERN, FEEDBACK CORRELATIONS

- THERMAL-HYDRAULIC INPUT -

  - COOLANT PARAMETERS - INLET FLOW, INLET TEMPERATURE, SYSTEM PRESSURE

  - FUEL ROD PARAMETERS - FUEL THERMAL CONDUCTIVITY, CLAD PROPERTIES, GAP HEAT TRANSFER COEFFICIENT

BWKIN-PDQ SCOPING STUDIES

- NORMALIZATION OF BWKIN TO PDQ
- BWKIN SHUTDOWN MARGIN
- STUCK ROD LOCATION DETERMINATION

BWKIN BOUNDARY CONDITION OPTIONS

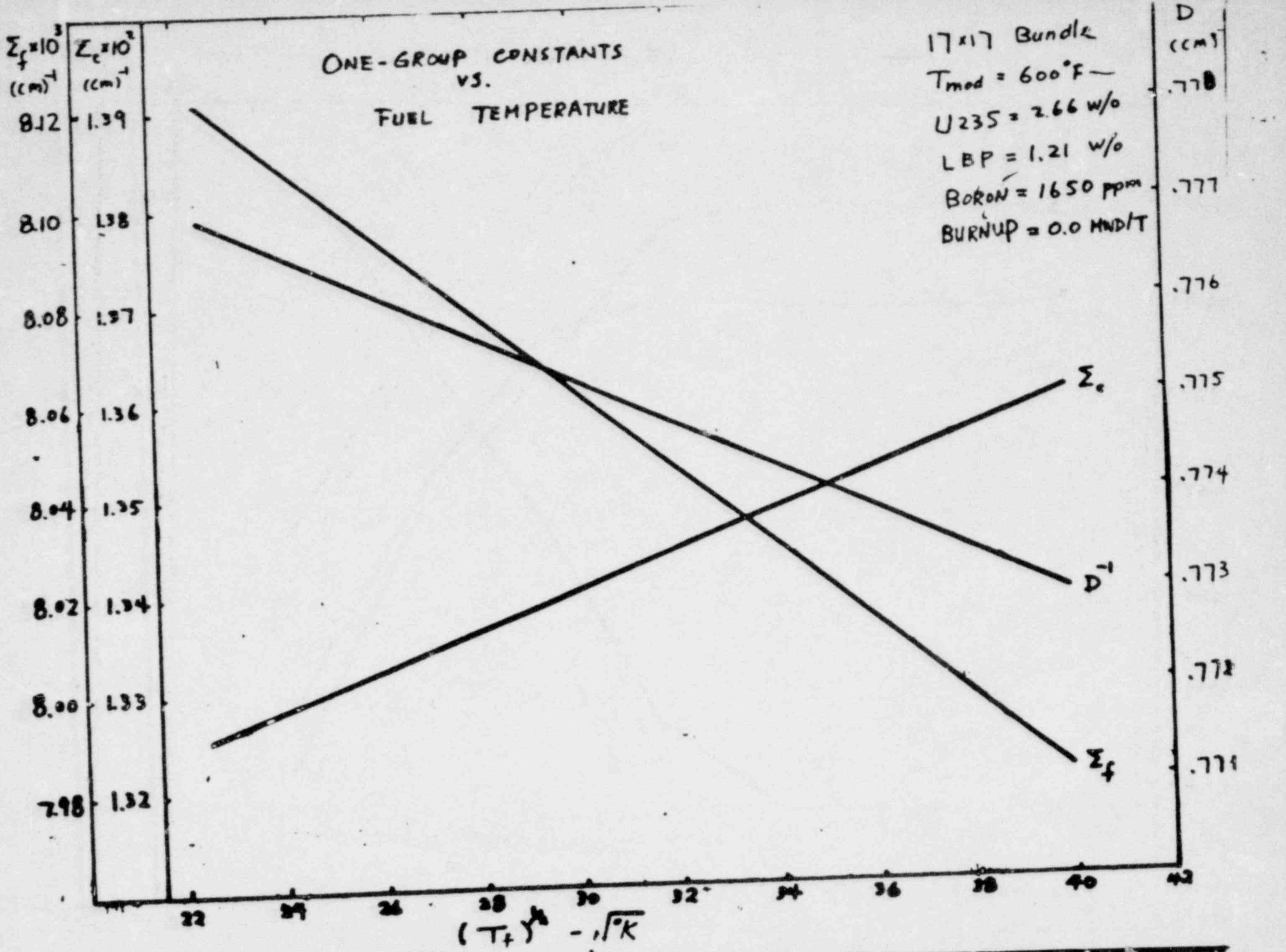
- ZERO NEUTRON FLUX
- ZERO NEUTRON CURRENT
- ALBEDO BOUNDARY CONDITION

BWKIN FEEDBACK CORRELATIONS

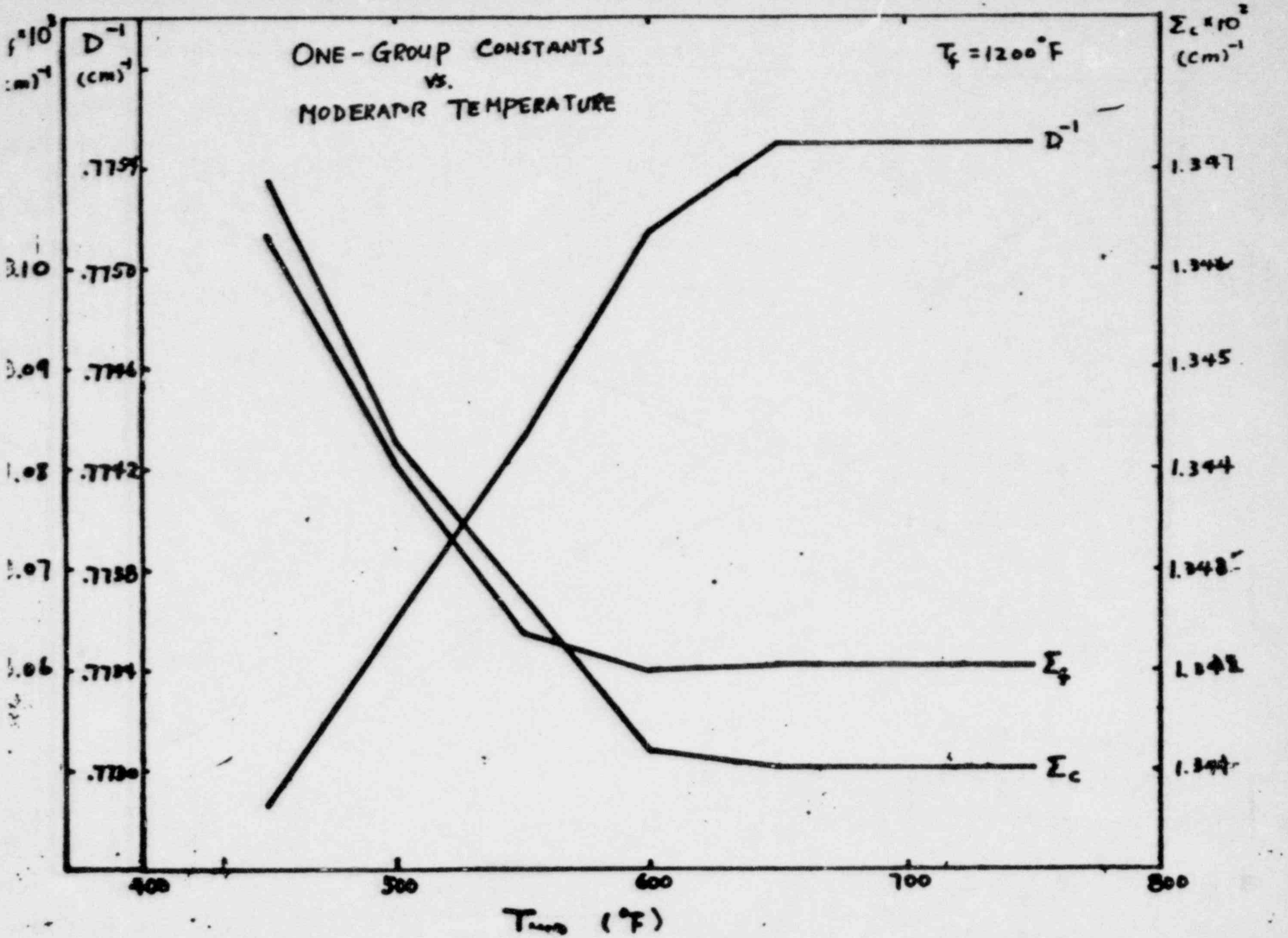
- LINEAR CORRELATION
- NON-LINEAR CORRELATION (FOR DOPPLER ONLY)
- MULTI-POINTS

SUBJECT No. Points = 68

3M CATALOG NO



ONE-GROUP CONSTANTS
VS.
FUEL TEMPERATURE
17x17 Bundle
Tmod = 600°F
U235 = 2.66 w/o
LBP = 1.21 w/o
BORON = 1650 ppm
BURNUP = 0.0 MWD/T
Σf x10^3 (cm)^-1
Σc x10^2 (cm)^-1
D (cm)
8.12
8.10
8.08
8.06
8.04
8.02
8.00
7.98
1.39
1.38
1.37
1.36
1.35
1.34
1.33
1.32
.778
.777
.776
.775
.774
.773
.772
.771
Σc
D^-1
Σf
22
24
26
28
30
32
34
36
38
40
42
(Tf)^½ - √°K


ONE-GROUP CONSTANTS
vs.
MODERATOR TEMPERATURE
$T_f = 1200°F$
$\Sigma_f \times 10^3$ (cm)$^{-1}$
D^{-1} (cm)$^{-1}$
$\Sigma_c \times 10^2$ (cm)$^{-1}$
D^{-1}
Σ_f
Σ_c
.7750
.7746
.7742
.7738
.7734
.7730
1.347
1.346
1.345
1.344
400
500
600
700
800
T_{mod} (°F)

SLB STUCK ROD

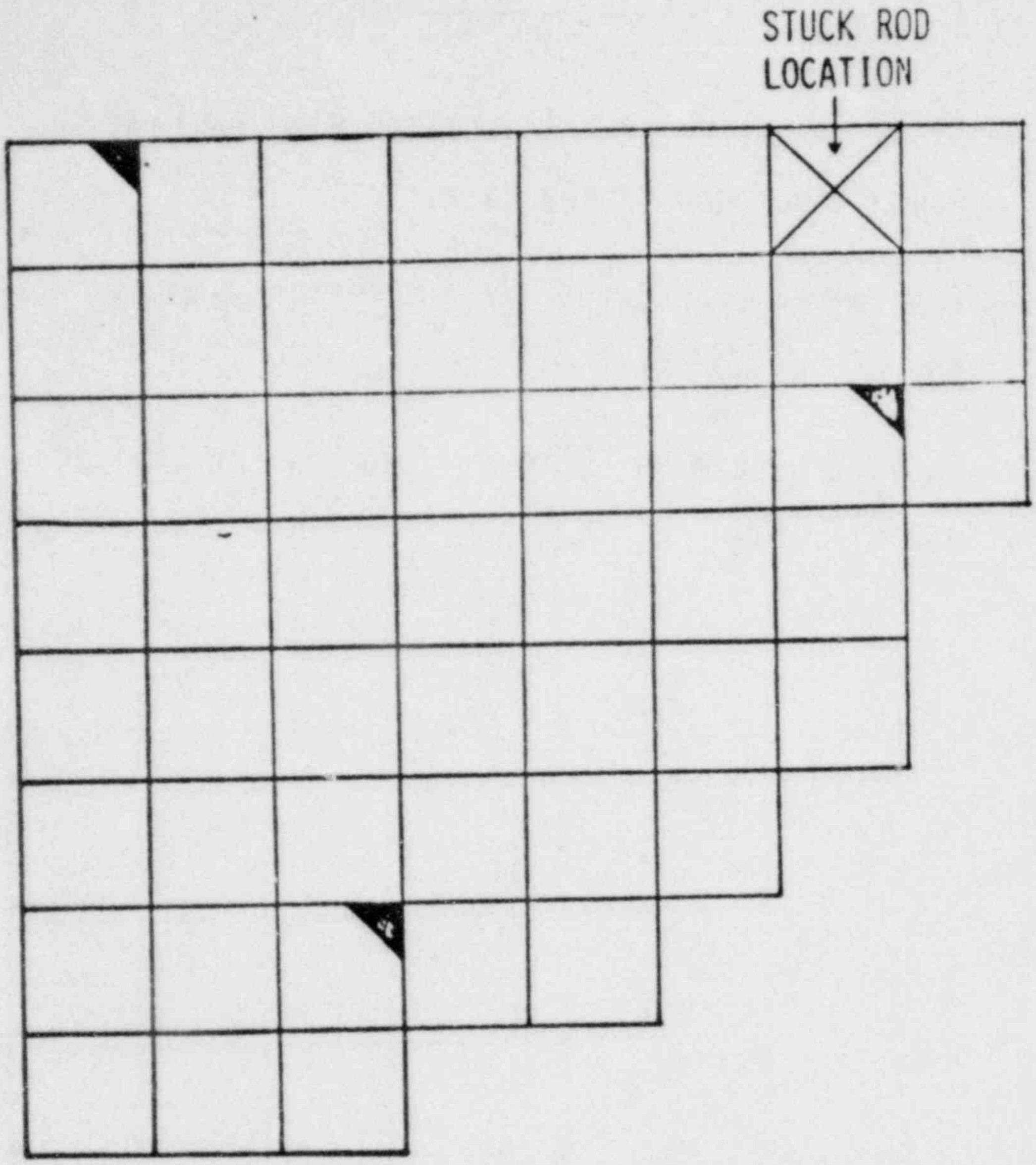
PROGRAM OBJECTIVES

-- STUDY TRANSIENT PEAK ASSOCIATED WITH MAXIMUM WORTH STUCK ROD DURING TRIP.

-- CONFIRM NO PROPAGATION IN THE LIMITED NUMBER OF PINS IN DNB DURING TRIP.

-- PROVIDE ANSWER TO NRC QUESTIONS 211.166, 211.168, 211.169, AND 211.171.

IBJECT RM

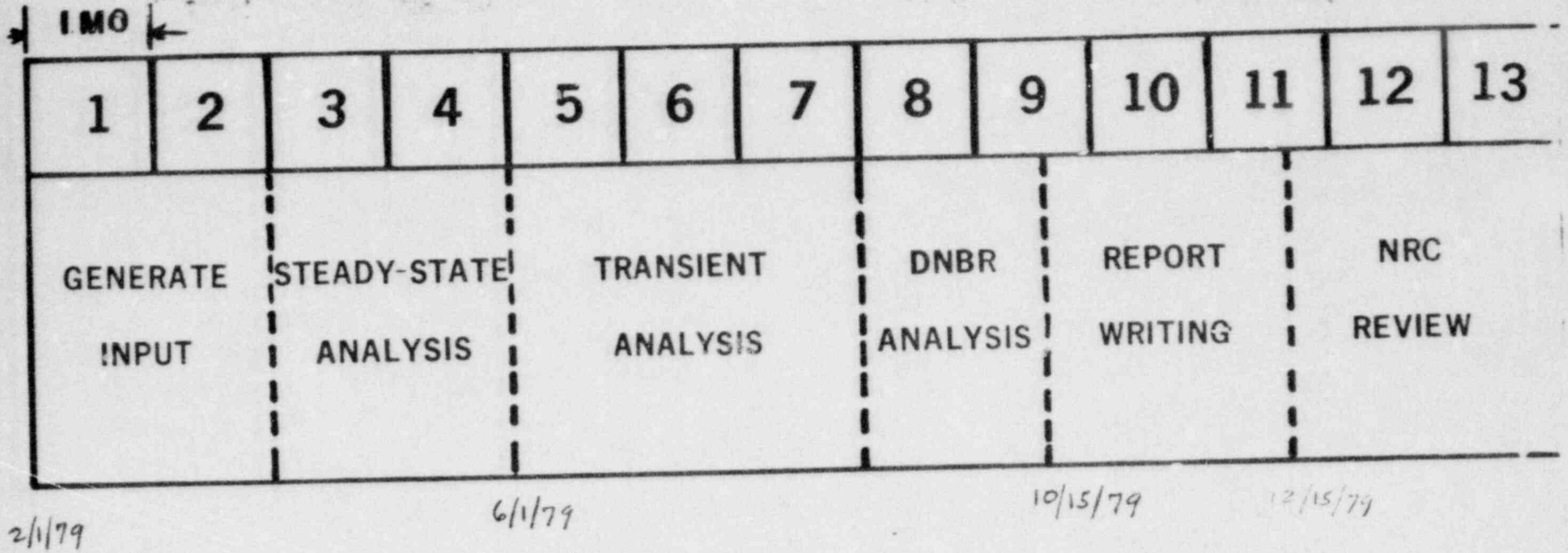


CORE CONFIGURATION - CPCo SLB/STUCK ROD
STUDY

NOTES

BWKIN SHUTDOWN MARGIN CONSIDERATION

- REALISTIC MODELING
- UNCERTAINTIES ON CONTROL ROD CROSS SECTIONS
- MAXIMUM ALLOWABLE INSERTED ROD INDEX
- POWER DEFICIT, HFP TO HZP



CPCo LICENSING SCHEDULE

NRC Rd2 QUESTIONS	DEC '78
SER	MAY '78
ACRS	JUNE '79
OL	NOV '80

MEETING AGENDA

CONSUMERS POWER COMPANY

MIDLAND PLANT UNITS 1 AND 2

JOB 7220

AUXILIARY BUILDING CRANE

NRC OFFICES, BETHESDA, MARYLAND

January 16, 1979

11:00 A.M.

ATTENDEES: NRC, CPCo, Bechtel, and Ederer

Agenda Item	Responsibility
I. Introduction	J. Zabritski (CPCo)
A. Statement of Meeting Purpose	
B. Review of NRC Questions	
C. Design Intentions Regarding Cask Dolly and Crash Pads	
II. Ederer's X-SAM System	W. Holloran (Holloran Assoc.)
III. Specifics of the Midland Retrofit	W. Clark (Ederer)
IV. Summary	
V. Questions	
VI. Review of Action Items	

12/16/1

MEETING AGENDA

CONSUMERS POWER COMPANY

MIDLAND PLANT UNITS 1 AND 2

JOB 7220

CONTAINMENT SUMP TESTING

NRC OFFICES, BETHESDA, MARYLAND

January 16, 1979

1:00 P.M.

ATTENDEES: NRC, CPCo, Bechtel, WCHL

	Responsibility
I. Introduction	J. Zabritski (CPCo)
II. Statement of Meeting Purpose	J. Zabritski
III. Review of Midland Design	M. Pratt (Bechtel)
A. Sump design and layout	
B. P&ID review - ECCS	
C. System flowrates	
IV. Discussion of Test Program	R. Elder (Bechtel)
A. Overview	
B. Previous testing	
C. Test procedures	
1) Series A tests	
2) Series B tests	
3) Series C tests	
D. Testing QA program	D. Hay (WCHL)
E. Test documentation and reporting	D. Hay
V. Analysis of Losses from Sump to Pumps	M. Pratt
VI. Summary	
VII. Questions	
VIII. Review of Action Items	

12/15/4

A brief summary of conclusions to date from tests on the ECCS containment sumps for J.M. Farley units 1 and 2, A.W. Vogtle, and Davis Besse and San Onofre Nuclear Plants.

1. Eddies and vorticity shed from structural members, valves, restraints, etc. are very weak in approach flows of 1 fps or less.

2. At velocities of less than 1 fps, the trash rack bars on the screen cages covering the sumps removed angularity and/or circulation in the flow as it passed through the trash racks. Flow exits from the trash rack normal to the plane of the grating.

3. A single layer of 1-1/4 in. by 3/16 in. flat bar grating with a spacing of 1-3/16 in. totally eliminated large free surface vortices which were forced to develop by turning vanes over an unprotected intake. This was demonstrated for both vertical and horizontal intakes of 10 to 24 in. diameter and for intake flows of up to 8600 gpm.

4. The single layer of grating was effective in eliminating vortices which otherwise would have had air core diameters ranging from 1/16 in. to approximately 2 in.

5. The most potentially adverse flow conditions at the intakes were established by blockage on the trash rack screens.

6. Vortices formed within the trash rack screen cage could be totally eliminated by a grating cage over the intake.

7. Grating acts as a flow straightener and eliminates the circulation necessary to support a vortex core.

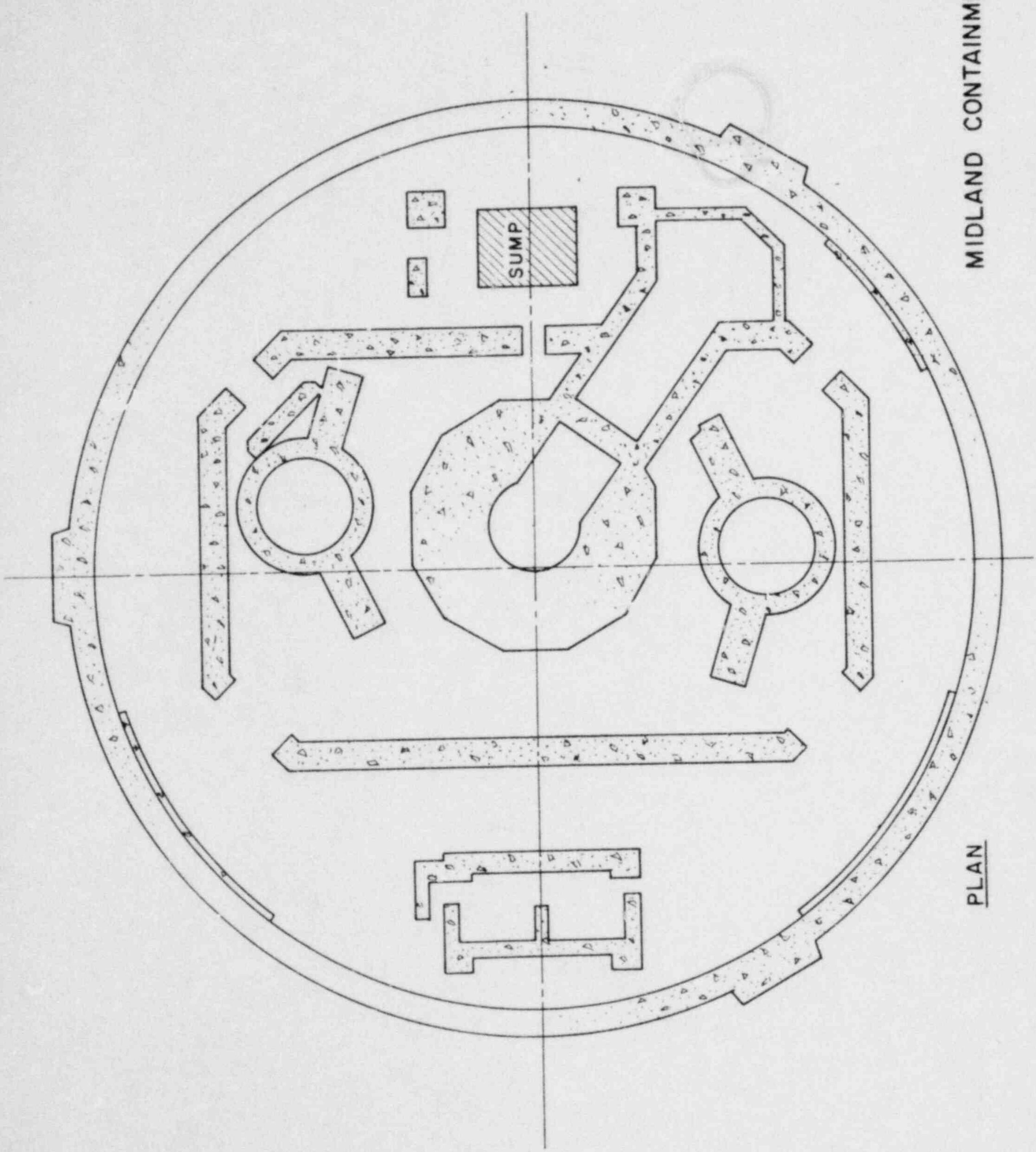
8. Intake loss coefficients with a grating cage in place were as follows:

   For the ANO-2 and SONGS plants:

ANO-2	SONGS*
1.01 to 1.25	1.42 to 1.55

   * includes loss in 2 elbows

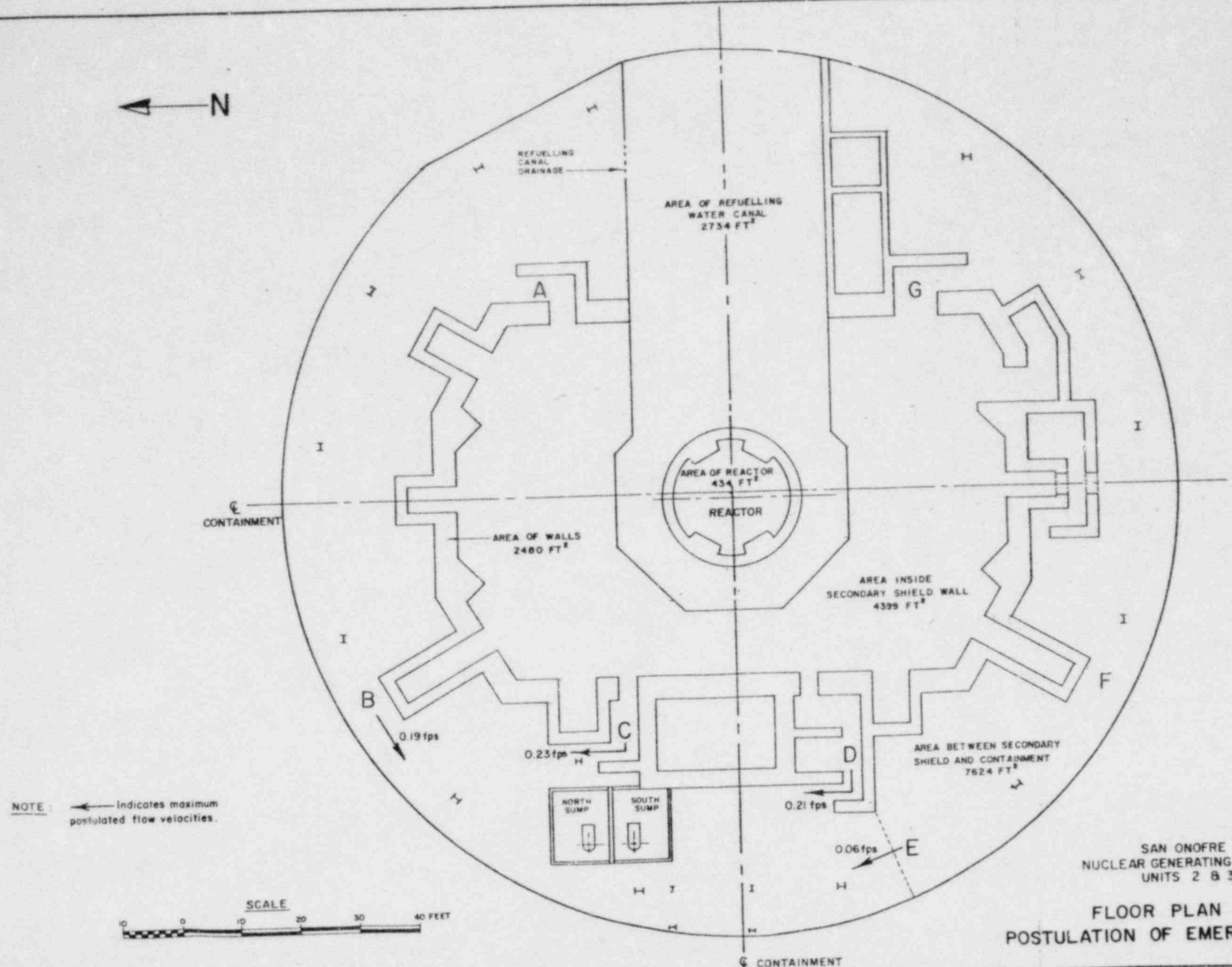
FIGURE 1



PLAN

MIDLAND CONTAINMENT

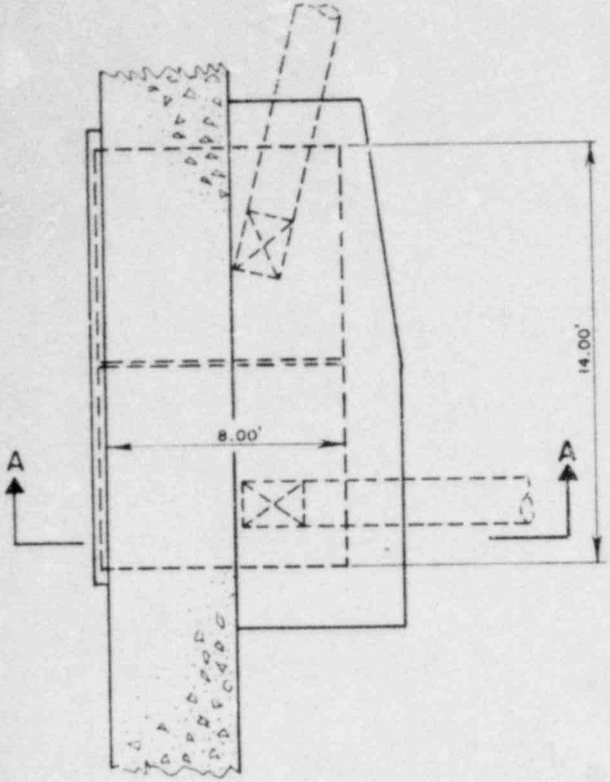
FIGURE 4



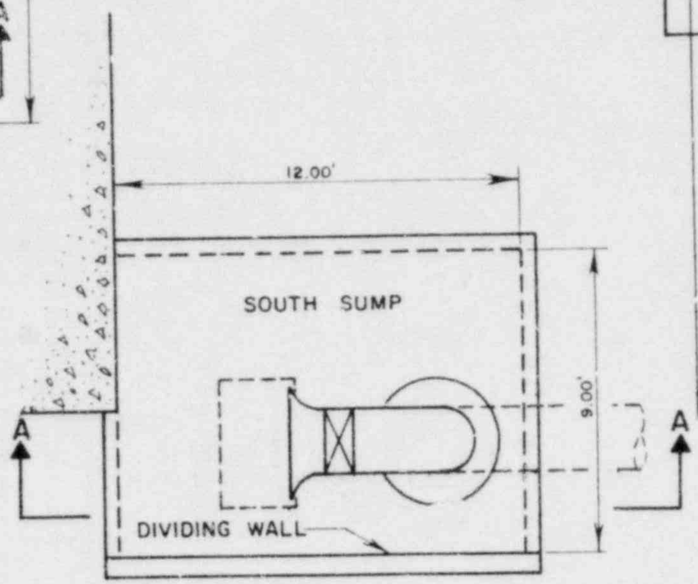
SAN ONOFRE
NUCLEAR GENERATING STATION
UNITS 2 & 3

FLOOR PLAN AND
POSTULATION OF EMERGENCY FLOWS

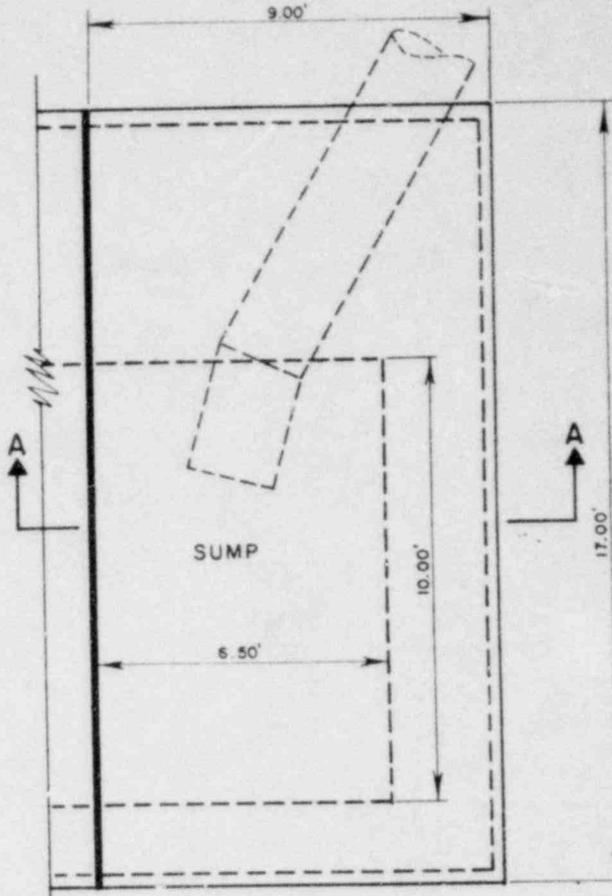
WESTERN CANADA HYDRAULIC LABORATORIES LTD.



ARKANSAS NUCLEAR ONE
UNIT 2

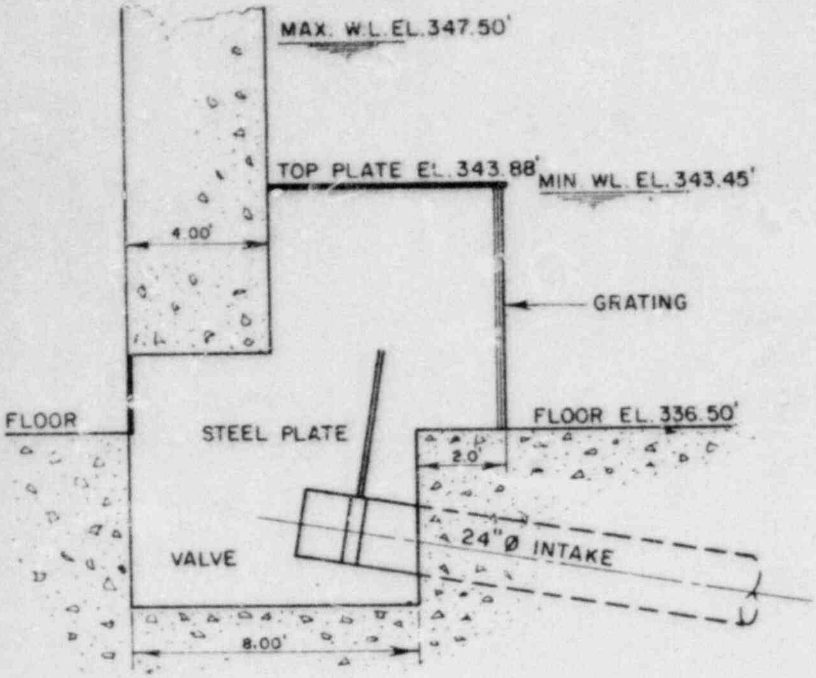


SAN ONOFRE NUCLEAR STATION
UNITS 2 & 3

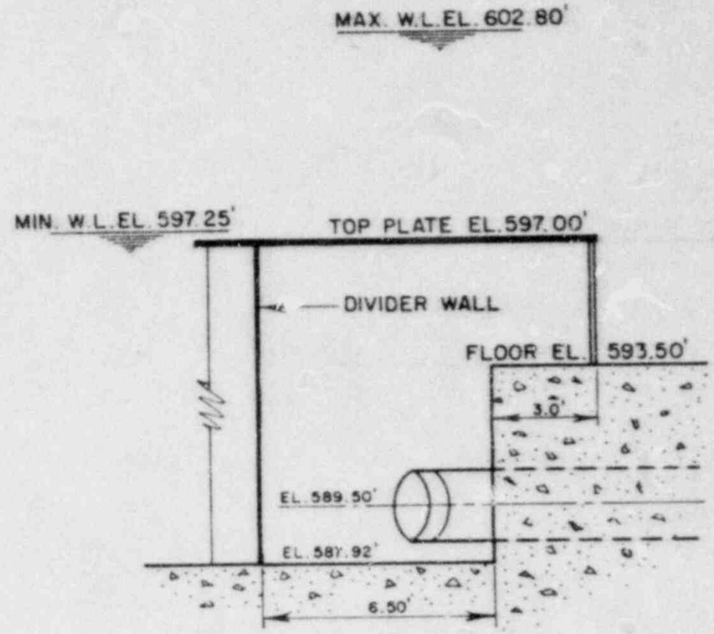


MIDLAND PLANT
UNITS 1 & 2

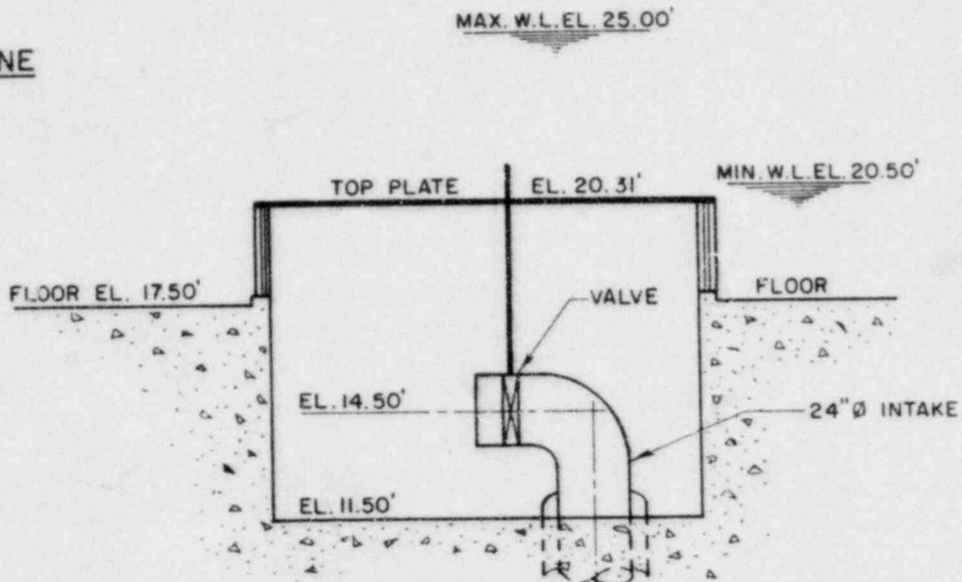
FIGURE 3



ARKANSAS NUCLEAR ONE
UNIT 2
(SECTION A-A)



MIDLAND PLANT
UNITS 1 & 2
(SECTION A-A)



SAN ONOFRE NUCLEAR STATION
UNITS 2 & 3
(SECTION A-A)

FIGURE 4

TABLE 1

DIMENSIONS AND OPERATING VARIABLES OF THREE PLANT INTAKES

INTAKE	ARKANSAS NUCLEAR ONE UNIT	SAN ONOFRE NUCLEAR STN UNITS 2&3	MIDLAND NUCLEAR PLANT UNITS 1&2
SIZE	24 in. diam	24 in. diam	24 in. diam
DESIGN DISCHARGE	3325 gpm	3900 gpm	4450 gpm
MINIMUM SUBMERGENCE	9.34 ft	6.0 ft	9.33 ft
TRASH RACK BAR SIZE AND SPACING	1-1/4" x 3/16" @ 1-3/16"cc	2-14" x 3/16" @ 1-3/16"cc	2-1/4" x 3/16" @ 1-3/16" cc
RANGE OF APPROACH VELOCITIES TO SUMP	0.13-0.50 fps	0.06-0.23 fps	0.35-0.50 fps
MAXIMUM SUMP WATER TEMPERATURE	210°F	190°F	227°F

RATIONALE FOR MIDLAND CONTAINMENT SUMP TESTS

1. Flow circulation, angularity and eddies generated by the "far field" will be eliminated by the trash rack bars. The trash rack is the model boundary.

2. Flow conditions without blockage due to the geometry outside the trash rack represents just one of numerous conditions that can be developed by blockage.

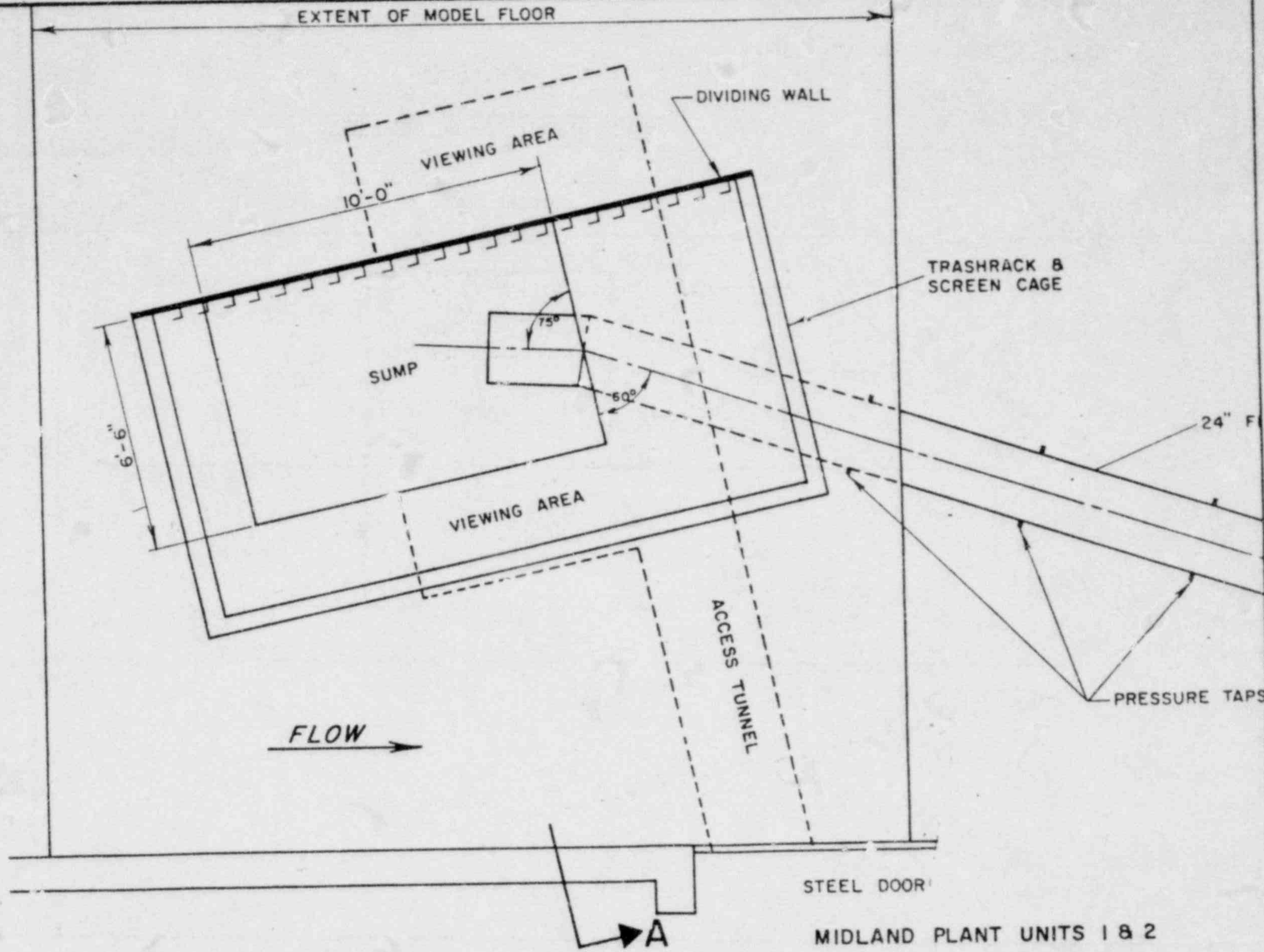
3. The two sumps are geometrically similar, subject to the same flow rates and depths of submergence therefore only a single sump need be modelled.

4. The effectiveness of a trash rack and/or a grating cage of similar size, and subject to similar flow rates, in precluding free surface vortices has been documented for other plants (J.M. Farley, Vogtle, ANO, SONGS). Therefore tests with and without the trash rack in place in which a free surface vortex is forced to develop without the trash rack are not necessary.

5. The potentially most adverse conditions for the intake are generated within the trash rack by blockage conditions. Tests will be conducted to show that a grating cage over the intake effectively precludes vortices from developing within the trash rack.

6. Intake loss coefficients and vortex formation are a function of Reynolds number. The model will be constructed at a scale of 1:1 and tests will be run at prototype Reynolds numbers equal to or greater than prototype values to give accurate results and minimize scale effects.

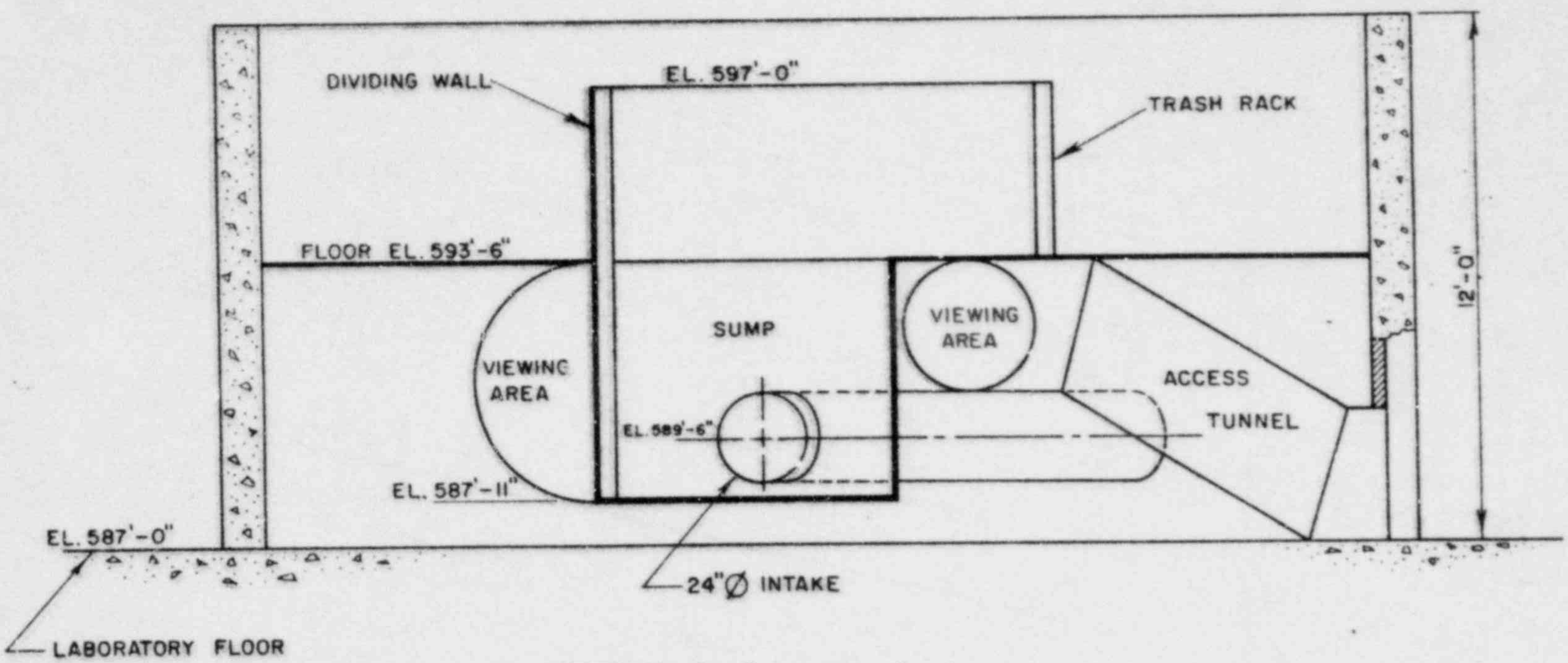
FIGURE 5



MIDLAND PLANT UNITS 1 & 2

PLAN OF TEST FACILITY

FIGURE 6



SECTION A-A (SCALE 1" = 4')

NOTE: Model section from Figure 1.

MIDLAND PLANT UNITS 1 & 2

SECTION OF TEST FACILITY

WESTERN CANADA HYDRAULIC LABORATORIES LTD.

bc'l 6638 A-WCH

CONSUMERS POWER COMPANY

MIDLAND PLANT

UNITS 1 AND 2

PROPOSAL

FOR

CONTAINMENT SUMP TESTING

SUBMITTED TO

BECHTEL POWER CORPORATION

BY

WESTERN CANADA HYDRAULIC LABORATORIES LTD.

PORT COQUITLAM, B.C.

OCTOBER, 1978

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	3.2 Model Description	6
4.	TEST PROGRAM	8
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	APPENDIX B - Personal Resumes	

LIST OF FIGURES

1. PLAN OF PROPOSED TEST FACILITY

2. SECTION OF TEST FACILITY

3. CONFIGURATION FOR TRASHRACK BLOCKAGE TESTS

1. SUMMARY

Hydraulic model studies are proposed at a 1:1 scale to assess vortex formation and to determine the trashrack and intake losses associated with the Midland Nuclear Generating Station Emergency Core Cooling System intakes following a LOCA.

The study will be undertaken in a 60 ft long by 25 ft wide by 12 ft deep concrete tank using water heated to 180°F. The model will consist of trashrack and screen cage and will reproduce all structural shapes, piping and ancillary equipment located inside the trashrack boundaries. The 24 in. dia. intake will be modelled using fibreglass pipe. Viewing windows in the tank will permit visual observation and video recording of flow phenomena in the sump.

Testing will be conducted at the minimum postulated operating water level with an augmented discharge of 7800 USgpm which will produce prototype Reynolds numbers in the model. Tests will document that positive vortex control is incorporated in the sump design by encapsulating the intakes with a grating cage. Intake loss coefficients will be determined and the accuracy of measurement established.

The model will be constructed and tested and a report issued within 4 months of receiving notice to proceed. The study is estimated to cost DELETED.

MIDLAND PLANT UNITS 1 AND 2

PROPOSAL FOR TESTING

CONTAINMENT SUMP

2. INTRODUCTION

This proposal for hydraulic model studies of the ECCS intake sump for Midland Plant Units 1 and 2 is based on data contained in a Bechtel Memorandum of June 20, 1978 and on the following Bechtel drawings number:

7220 - C - 332(Q)-6	7220 - C - 623(Q)-6
- C - 335(Q)-9	- C - 624(Q)-10
- C - 354(Q)-7	- C - 630(Q)-3
- C - 355(Q)-7	- C - 637(Q)-9
- C - 371(Q)-10	- C - 646(Q)-5
- C - 372(Q)-8	- C - 651(Q)-9
- C - 381(Q)-6	- H - 610 SH3(Q)-2
- C - 462(Q)-2	- H - 612 SH3(Q)-7
- C - 463(Q)-2	- M - 179(Q)-2
- C - 491(Q)-1	- M - 300(Q)-1
- C - 495(Q)-1	- M - 301(Q)-3
- C - 496(Q)-1	- M - 302(Q)-3

2.1 Purpose

The purpose of the model studies is to investigate possible vortex formation at the ECCS intakes and to assess head losses through the trashrack and screen cages and through the intake. Vortices, if they were to occur, could cause unexpectedly high intake losses, loss of pump capacity due to air entrainment and pump failure due to vibration. High intake losses may impair the ability of the spray or LPI pumps to draw a suction on the sump, or the ability of the HPI pumps to take a suction from the LPI pump discharge.

2.2 Intake Description

The ECCS pumps will be supplied by two 24 in. diameter intake pipes which protrude horizontally into sumps at centerline el 589.50 ft. Each intake pipe will draw from a 10.0 ft long by 6.5 ft wide by 5.85 ft deep sump which is formed by dividing a 13 ft long by 10 ft wide pit across its width. The sump floor is at el 587.92 ft. The dividing wall extends upwards to the top cover plate and across the full width within the trashrack. The entire trashrack enclosure will be covered by a flat cover plate. The elevation of this cover plate is to be confirmed by Bechtel.

The trashracks are formed of 3-1/2 in. by 3/8 in. vertical bars spaced at 1-3/8 in. centers with crossbars spaced at 2 in. A medium screen of 3/8 in. square opening and a fine screen with 0.04 in. openings will be inside the trashracks. A flat floor area between 1.75 ft and 5.75 ft wide surrounds the sump inside the trashrack.

The expected normal operating discharge per intake is 4450 USgpm with a possible maximum of 6000 USgpm at runout conditions. Total flow through both intakes may reach 12000 USgpm during simultaneous runout conditions. The anticipated post LOCA water temperature may reach 227°F. The minimum postulated post LOCA water level in the sumps is 596.0 ft with a possible maximum water level of 602.8 ft.

3. THE MODEL

3.1 Rationale of Study

It has been found in previous studies for the Davis Besse Nuclear Generating Station that the vortex formation process cannot be reliably modelled at scales below 1:1. A 1:1 scale using water heated to a maximum of 180°F is proposed for this study.

Tests on similar ECCS sumps indicated that the trashracks acted as flow straighteners for the range of approach velocities postulated for each plant during post LOCA conditions. The flow straightening ability of the grating effectively "uncoupled" flow conditions within the sump from the effect of the containment geometry, structural members and piping external to the trashrack. It was shown that screen blockage was predominant in establishing flow conditions within the sump.

The trashrack size and range of approach velocities for three other plants tested are compared below to the Midland Plant.

Plant	Trashrack Bar Size And Spacing	Range of Approach Velocities, fps
J.M. Farley - Unit 2	1-1/4" x 3/16" @ 1-3/16"cc	0.14 - 0.53
Arkansas Nuclear One - Unit 2	1-1/4" x 3/16" @ 1-3/16"cc	0.13 - 0.50
San Onofre Generating Station	2-1/4" x 3/16" x 1-3/16"cc	0.06 - 0.23
Midland - Units 1 & 2	2-1/4" x 3/16" @ 1-3/16"cc	Approx.0.35 - 0.50

It can be seen from the above that the depth to spacing width of the Midland trashrack bars is equal to or greater than the other plants tested while approach velocities are similar. The Midland trashrack will be an effective flow straightener and therefore an adequate model boundary.

The main sump of the Midland plants is divided into two geometrically similar sumps, one for each train. The main sump features with respect to vortex potential and intake losses, such as intake diameters, flow rates, depth of submergence, and overall geometry are similar for the two sumps. There are two minor dissimilarities. The trashrack clearance from the edge of the sump is 1.0 ft less on one side of the sump than on the other and the alignment azimuth of one intake leads directly from the sump whereas the second intake makes a 15° bend as it passes through the sump wall. Neither of these differences is significant relative to vortex potential or intake losses when compared to the predominant influence of screen blockage. It is proposed that only one sump be modelled and tested. The test results will be applicable to both sumps in both Units 1 and 2.

Modelling and testing one of two geometrically similar sumps was undertaken by W.C.H.L. for the ANO-2 and SONGS plants.

The tests would be conducted on the minimum postulated water level since this produces the maximum velocities through the screen, the lowest ambient pressure in the intake, and thus the greatest potential for vortices to develop.

3.2 Model Description

A 10.0 ft long by 6.5 ft wide by 5.85 ft deep sump will be constructed in a 60 ft long by 25 ft wide by 12 ft deep concrete tank, Figure 1 and 2. The sump will be an exact 1:1 scale model of the North sump of Unit 1 and South sump of Unit 2.

A 24 in. diameter fibreglass intake pipe will enter the sump horizontally at centreline el 589.50 ft. The pipe will be carried straight and level for a distance of 18 pipe diameters beyond the intake before a bend is introduced leading the pipe to an exit port through the tank wall. The 30 in. diameter shroud will cover the 24 in. diameter intake within the sump.

The solid divider wall will be constructed along one side of the sump and extending the full length of the trashrack enclosure to a top el 597.00 ft. The trashrack and screen cage will be constructed to top el 597.00 ft around the sump.

All auxilliary equipment or structures inside the trashrack enclosure, such as columns and water level recorders, will be modelled to el 599.00.

All proposed testing will be carried out at the minimum postulated water level. The top of the trashrack cage will be left open unless it is divided to construct a cover plate below the minimum water levels.

An observation tunnel with viewing ports will be constructed to permit viewing for vortex formation around the intake.

The water in the tank will be heated using two 2.5×10^6 BTU/hr gas heaters. Flow through the intake will be recirculated to diffusers at each end of the tank using a 75 HP pump.

Piezometer taps will be installed in the floor inside and outside of the trashrack cage and in the 24 in. diameter pipe.

4. TEST PROGRAM

The main test program to examine flow conditions at the intake and to determine head loss coefficients across the trashrack and grating cage will be carried out in three test series, Series A, B and C, Table 1.

Test Series A and B will examine flow conditions at the intake entrance and determine loss coefficients with a water temperature of 180°F and discharges augmented above prototype flows to produce Reynolds numbers equivalent to those occurring in prototype.

Test Series A will examine the intake without blockage, both with and without the grating cage in place and with five rationally determined 50% trashrack blockage conditions, Figure 3.

Test Series B will demonstrate the effectiveness of the grating cage to suppress internal vortices which will be generated using experimentally determined conditions of 50% or greater trashrack blockage. Tests will be run at a model discharge of 7800 USgpm, developing Reynolds numbers equivalent to prototype operation at 6000 USgpm and 227°F temperature, and at the maximum model discharge to test the conservatism of the design. Tests will be run at plant minimum water level.

It is our experience that the formation of a wall or floor vortex is not solely a function of percent blockage but also a function of where blockage occurs. This is a central weakness in all non-generic solutions, as one cannot be sure that all possible blockage configurations have been tested. The purpose of Series B tests is to force the formation of a wall or floor vortex, without the grating cage in place, and to demonstrate that the grating cage over the intake pipe will preclude the formation of such vortices.

The test sequence in this phase will be as follows:

1. The grating cage will be removed and blockage conditions established which produce a wall or floor vortex entering the intake with an air core. The blockage will be equal to or greater than 50 percent of the screen area.
2. The grating cage will be reinstalled for the blockage condition above and the effect of the cage on the vortex will be noted.
3. The discharge in the model will be increased to demonstrate the conservatism of the grating cage design with respect to vortex prevention.

Test Series C will consist of 20 tests with 50 percent blockage to determine a mean value of the intake loss coefficient and to establish confidence limits.

The following parameters will be recorded during the test program:

1. Flow rate
2. Water Temperature
3. Intake elements in place, that is, screen and/or grating cages
4. Piezometric levels
5. A written description of flow conditions

The intake loss coefficient will be calculated from the piezometric levels for each test.

Photographs and/or video tape records will be taken where feasible.

5. REPORTING

A tablulated test program, together with a detailed sketch of the test arrangement, will be forwarded for approval prior to commencing construction and testing.

The study will be undertaken following the Q/A program of Western Canada Hydraulics Laboratory, Appendix A.

Bi-monthly status reports will be forwarded after commencement of construction.

A short form report will be prepared within two weeks of completing the test program. This will be prepared to facilitate SCE's submission to NRC.

A final report will be prepared covering the purpose, program, procedures, results and conclusions of the study. The report will include the test data, and results of previous experience, and positive conclusions drawn with respect to the adequacy of the sump design in preventing the formation of air-entraining vortices. A draft of the final report will be submitted for approval.

6. ESTIMATED TIME AND COSTS

This section deleted

Pages 11, 12 and 13 removed

7. PERSONNEL

All proposed work will be reviewed and approved by Mr. D. Hay, Managing Director of Western Canada Hydraulic Laboratories Ltd.

The studies will be carried out under the direction of Mr. W.A. McLaren, P. Eng., Head of the Laboratories' Special Projects section. The project engineer will be Mr. W. Schriek, P. Eng. Biographical resumes of these staff members are presented in Appendix B. Supporting staff consisting of engineers, technicians and skilled tradesmen will be available from W.C.H.L. staff as required.

Close liaison will be maintained during the program with Bechtel engineers. W.C.H.L. encourages the participation of Client personnel in studies at the Laboratory and is prepared to make available a limited amount of office space, if required.

TABLE I

PROPOSED TEST PROGRAM

Series A - Primary Objectives: For the unblocked trashrack and five rationally selected blockage conditions determine trashrack and intake loss coefficients and demonstrate that no vortices occur. Determine the effect of the grating cage on the intake loss coefficient.

Test Number	Discharges USgpm	Water Level Elevation, ft	Temperature °F	Blockage Condition (Figure 3)	Grating Cage In Place
A1	7800	596.0	180	None	No
A2	7800	596.0	180	None	Yes
A3	7800	596.0	180	A	Yes
A4	7800	596.0	180	B	Yes
A5	7800	596.0	180	C	Yes
A6	7800	596.0	180	D	Yes
A7	7800	596.0	180	E	Yes

Series B - Primary Objective: To demonstrate the effectiveness of the grating cage to suppress vortices.

Procedure:

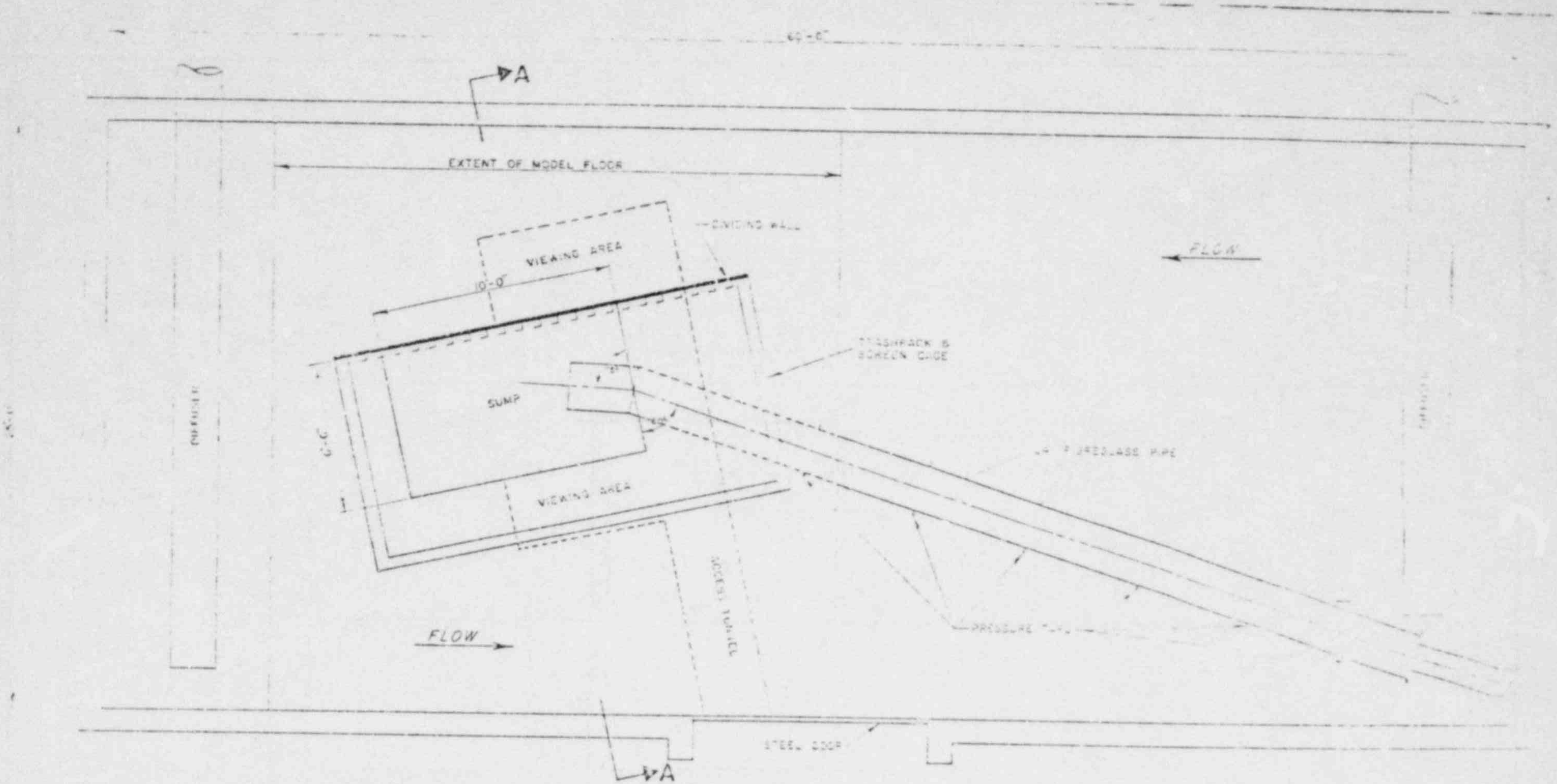
1. Without the grating cage in place experimentally determine blockage conditions that generate vortices from either the sump walls, floor or ceiling.
2. For selected blockage conditions from (1), conduct the test sequence described below. Tests conducted at an intake discharge greater than the design discharge demonstrate the conservatism of the design.

Test Number	Discharges USgpm	Water Level Elevation, ft	Temperature °F	Blockage Condition	Grating Cage In Place
B1	7800	596.0	180		No
B2	7800	596.0	180		Yes
B3	Max	596.0	180		Yes

TABLE 1 (cont)

Series C - Primary Objective : Repeat a 50 percent blockage test to show test results reproductibility, and subsequently determine the mean loss coefficients, standard deviation and confidence limits.

Test Number	Discharges USgpm	Water Level Elevation, ft	Temperature ^oF	Blockage Condition	Grating Cage in Place
Cl to C20	7800	596.0	180	A	Yes

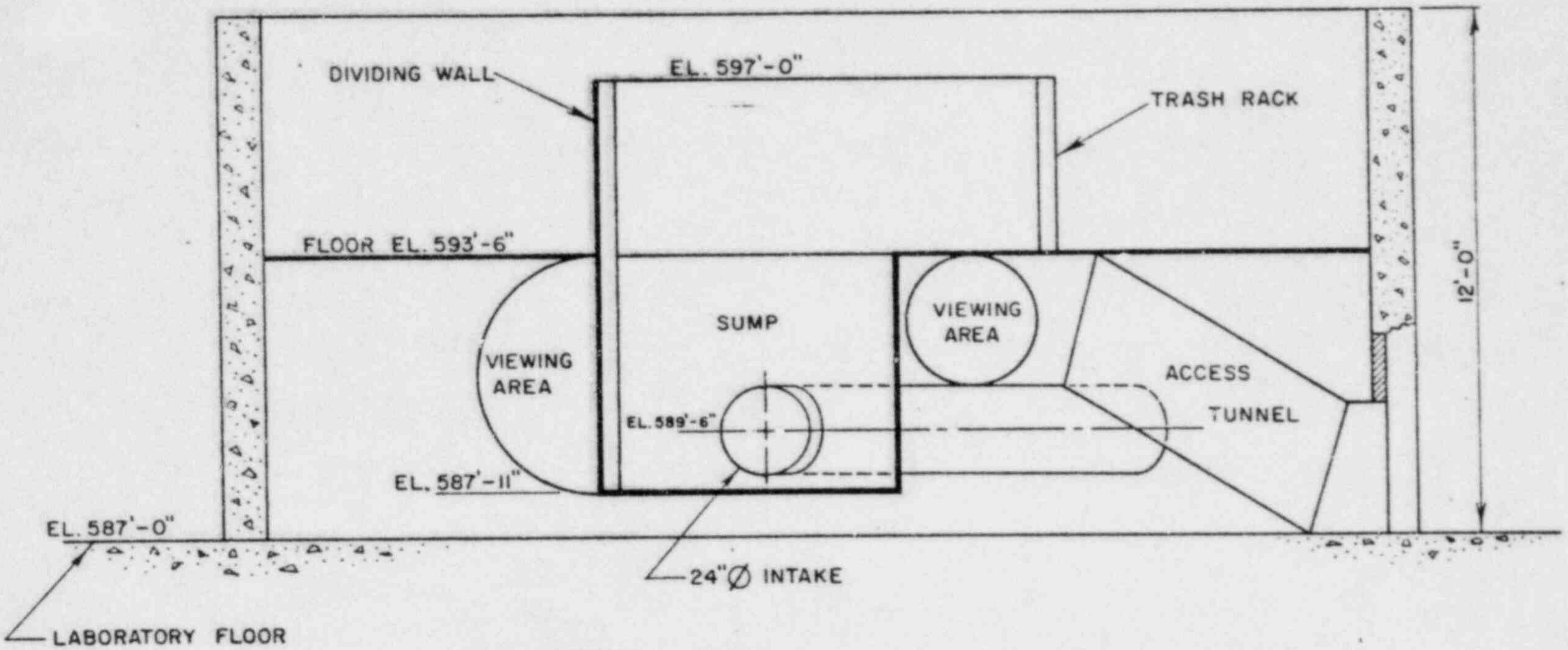


PLAN (SCALE ...)

NOTE Section A-A shown on Figure 2.

MIDLAND PLANT ...

PLAN OF PROPOSED ...



SECTION A–A (SCALE 1" = 4')

NOTE: Model section from Figure 1.

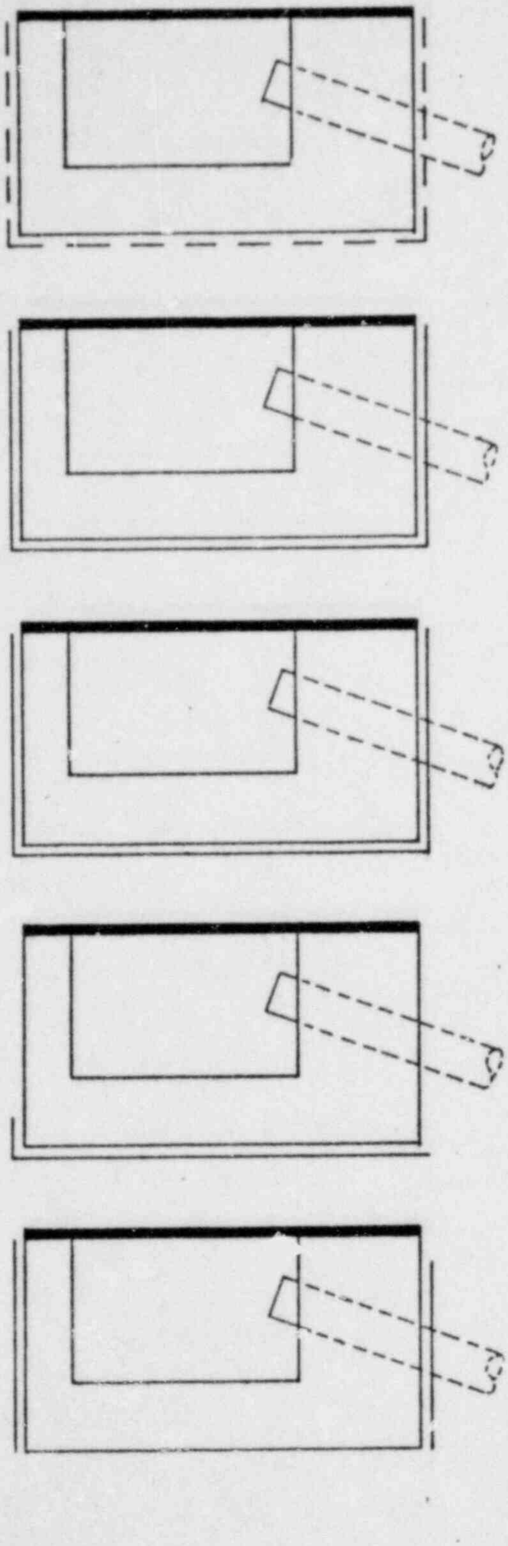
MIDLAND PLANT UNITS 1 & 2

SECTION OF TEST FACILITY

FIGURE 2

WESTERN CANADA HYDRAULIC LABORATORIES LTD.

bc-1 6638 A-WCH



A - DEBRIS UNIFORMLY DISTRIBUTED.
TRASH RACK BLOCKED 50% OVER FULL HEIGHT BY ALTERNATE 3" WIDE OPEN AND BLOCKED STRIPS.

B - TOP HALF BLOCKED BY FLOATING DEBRIS.
TRASH RACK BLOCKED OVER UPPER ONE HALF AROUND PERIPHERY.

C - LOWER HALF BLOCKED BY SUBMERGED DEBRIS.
TRASH RACK BLOCKED OVER LOWER ONE HALF AROUND PERIPHERY.

D - UPSTREAM HALF BLOCKED BY DEBRIS.
TRASH RACK BLOCKED OVER FULL HEIGHT OVER 50% OF ITS AREA IN THE FLOW PATH.

E - UPSTREAM HALF BLOCKED BY DEBRIS.
TRASH RACK BLOCKED OVER FULL HEIGHT OVER 50% OF ITS AREA IN THE FLOW PATH.

▬ INDICATES SOLID WALLS
— INDICATES TRASH RACK BLOCKAGE

MIDLAND PLANT UNITS 1 & 2

CONFIGURATION FOR TRASH RACK BLOCKAGE TESTS

WESTERN CANADA HYDRAULIC LABORATORIES LTD.

BCIL 5687A-WCH

APPENDIX A

QUALITY ASSURANCE REQUIREMENTS

FOR

PHYSICAL MODEL STUDIES

1. PROJECT ORGANIZATION

All laboratory projects are under the direction of the Managing Director. Each project is assigned a Project Engineer and Project Technician. Additional short term technical staff for design, construction and/or testing is drawn from the technical pool or other projects.

The functions of project personnel are, but not necessarily limited to, the following:

Managing Director

- Approves model designs and modifications prior to forwarding for the Client's approval.
- Approves test programs prior to forwarding for Client approval.
- Approves test procedures.
- Reviews data collection techniques, records, and data analysis to confirm checks have been made, adequate records taken, and test results and analysis are consistent with test procedures and objectives.
- Reviews and approves interim and final reports.

Project Engineer

- Provides day to day supervision of model construction, testing and data analysis.
- Checks conformance of model construction and modifications to approved drawings.
- Initiates test program and procedure for approvals.
- Initiates modifications for approval.

- Undertakes and/or supervises tests.

- Reduces and/or supervises reduction of test data.

- Arranges for independent checks on data collected, data reductions and design calculations.

- Supervises instrumentation calibration and checks.

- Prepares report drafts.

Testing Technician

- Provides day-to-day technical support to the Project Engineer.

- Operates the model under the direct supervision of the Project Engineer.

- Maintains equipment, instrumentation and photographic records.

Project Records are kept in:

a. Correspondence files. Incoming correspondence is dated and routed for initialling. All attachments or enclosures remain in the correspondence files except photographs and plans.

b. Plan files. Incoming Plans are dated the day received. A list of plan numbers is kept in the project work books. Plans are filed in a drawer.

c. Work Books. Three ring binders are used for keeping test procedures, schedules, plan lists, design calculations, data, data analysis and draft reports.

All files, work books and plans are bound together upon completion of the project and placed in storage for at least 15 years.

2. DESIGN AND CONSTRUCTION OF THE MODEL AND MODIFICATIONS

Design work is initiated by the Project Engineer and approved by the Managing Director. Model construction is supervised by the Project Engineer. Model dimensions will be checked independently of the person responsible for construction. The principal checker will be the Project Engineer.

3. TESTING

Test program will be initiated by the Project Engineer, approved by the Managing Director and forwarded to the client for approval. The test program will identify the objective of each phase and/or series of tests and identify each test with a number.

If as a result of test results, or other information, modifications are considered necessary to the model or test program, a revised test program will be forwarded for approval.

Test procedure for the operation of the model will be initiated by the Project Engineer and approved by the Managing Director. Revisions to the test procedure will be approved by the Managing Director.

Flow measuring orifice plates and weirs will be calibrated prior to commencing the test program and a dated record kept in the work books. The calibration would be checked should the testing exceed 6 months. Other instruments, as required, will be calibrated and adjusted if necessary, prior to use, under supervision of the Project Engineer.

Data collection will be under supervision of the Project Engineer. Data will be recorded on data sheets which will note the project number, run number, data, test flows, and items measured. Periodic checks on obtained data will be made by an independent observer, that is, data taken by the Project Technician will be checked by the Project Engineer, and vice versa.

Generally, data will be reduced as generated to examine trends and consistency of results.

A photographic log will be kept noting photo number, test number and date of exposure. Prints and negatives are kept in work books.

4. REPORTS

A draft of the final report will be prepared by the Project Engineer and reviewed by the Managing Director. Following any necessary revision, a copy of the report draft may be sent to the client for further comment prior to printing if so required. Transferral of data from work books, or calculation sheets, to graphs and drawings will be checked by the Project Engineer.

Reports will be approved and signed by the Managing Director.

APPENDIX B

PERSONAL RESUMES

D. HAY

A. McLAREN

W. SCHRIEK

DUNCAN HAY

MANAGING DIRECTOR, WESTERN CANADA HYDRAULIC LABORATORIES LTD.

EDUCATION
B.A.Sc. (Civil), University of British Columbia, 1964
M.S. (Hydraulics), University of California, Berkeley, 1967
Dip. H.E., Delft Technological University, Delft, 1968

REGISTRATION
Professional Engineer in Province of British Columbia

MEMBERSHIPS
Associate Member, American Society of Civil Engineers
Member, Permanent Association of International Congresses
Member, International Association for Hydraulic Research

EXPERIENCE

1970 - date
Western Canada Hydraulic Laboratories Ltd., Vancouver, B.C.
Director
Managed and provided technical direction for the following studies

Hydraulic Structures

- Approach Conditions to Howell-Bunger Valve, Soroako; Marsh Lake Dam; Columbia River, Mica and Revelstoke Projects: Peace River, Site 1 Development; Pend-d'Oreille River, Seven Mile Project; Churchill River, Missi Falls and Notigi Control Structures; Nelson River, Upper Limestone Site Integrated Powerplant and Conventional Powerplant; Beaver Creek Spillway, Alberta; Skins Lake Spillway; Ain Zada Spillway Algeria; Fermatou Howell-Bunger Valve Outlet Structure, Algeria;

Coastal and Harbour Model Studies

- Flushing in Small Craft Harbours; Cape Tormentine Ferry Terminal; Point Grey Erosion; Delta Stabilization; Silver Bay, Lake Superior; Wind and Wave Studies, Beaufort Sea; French Creek Boat Harbour; Deas Slough Marina; Oak Bay Harbour; Royal Victoria Yacht Club; Pacific Environment Institute, Quanicassee Nuclear Powerplant; Fraser Survey Docks Extension, Floating Breakwaters; Chemainus Harbour; Gabriola Island Ferry Terminal; Oyster River Estuary; Jericho Beach; Coburg Peninsula; Landslide Generated Waves, Kitimat Inlet; Cooling Water Intake Structure; Pilgrim Nuclear Plant:

River Studies

- Thompson River Erosion, Fitzsimmons Creek Flood Levels; Fraser River, Steveston Harbour, River Studies (contd.)

Trifurcation Phase III; Infill, Bristol Island; Borrow Pit Migration, Fraser and Pitt Rivers; Vedder River Sedimentation:

Special Studies

- Drop Structures, Poplar Creek; Emergency Cooling Pump Intakes, Nuclear Plants; LNG Pumping Station, Algeria; Flow Circulation Fish Holding Tanks, Beaver Creek Diversion; Island Copper Outfall, Anaconda Britannia Mines Outfall; Kitsault Outfall; Sundance Cooling Pond and Discharge Structure; Port Hardy Breakwater; Libby Dam Releases; Fish Pumps; Oilwater separators; Belle River Nuclear Plant Intake and Diffuser Design, Michigan; Pilgrim Nuclear Plant Circulating Water Intake Structure, Massachusetts:

1964 - 1970 Department of Public Works of Canada

Regional Coastal Engineer and Territorial Engineer

-Suitability of Air Bubble Breakwaters for Use on B.C. Coast.

W.A. MCLAREN

SENIOR ENGINEER

EDUCATION

Bachelor of Engineering (Civil), McGill University, 1960
Master of Science (Glaciology), University of Melbourne, 1968
Engineering Aspects of Heat Disposal from Power Generation - Summer Session Course, Massachusetts Institute of Tech. 1975

MEMBERSHIPS

Member, Canadian Society for Civil Engineering
Member, Permanent International Association of Hydraulic Research.

AWARDS

Polar Medal

EXPERIENCE

197? - date

Western Canada Hydraulic Laboratories Ltd., Vancouver, B.C.
- Small Boat Harbour Flushing Study
- Cape Tormentine Ferry Terminal - Breakwater relocation
- Reserve Mining Co. - Stabilization of delta foreshore
- Beaufort Sea Study - Meteorology and wave analysis
- Sonatrach LNG Plant - Vortex elimination in pump bays
- Gabriola Island Ferry Terminals - Wind, wave and current assessments
- Warm Water Storage - Stratification of water densities in storage tank
- Sundance Cooling Pond - Cooling pond currents
- Vogtle Nuclear Plant - Emergency cooling system flows
- Arctic Oilspill Equipment - Pump and separator assessment

1971 - 1973

Willis Cunliffe Tait and Co. Ltd., Terrace, B.C.
- Consulting Engineer for communities along Skeena River
- Eurocan Pulp and Paper Co. Ltd. - River training works and infiltration gallery
- Flood damage restoration and river bank protection

1969 - 1970

- Skipper of own 48-ft schooner in Pacific Ocean

1967 - 1969

Sinclair and Knight, Sydney, Australia
- Design of intake works, Carcoar Dam
- Feasibility study for irrigation dams, N.S.W.
- Feasibility studies and design for sewage treatment works

1964 - 1967	Australian Antarctic Division - Wilkes, Antarctica, 1965 glaciological study - Thermal ice corer observations, Byrd Station, Antarctica.
1961 - 1963	George Wimpey Central Laboratories, London, U.K. - Hydrographic and oceanographic survey for Jebal Dhanna oil port development, Persian Gulf - Hydraulic model studies of Dover, Port Talbot, Das Island harbours
1960 - 1961	Canadian Hydrographic Service - Hydrographic surveys in Lancaster Sound, Frobisher Bay, Moosonee and Great Lakes

March, 1978

W. SCHRIEK

HYDRAULIC ENGINEER

EDUCATION	School for Civil Technology, Netherlands, 1952 B.E., Civil, University of Saskatchewan, 1961 M.Sc., Hydraulics, University of Saskatchewan, 1963 C.E., Hydrodynamics, Massachusetts Institute of Technology, 1966
REGISTRATION	Association of Professional Engineers of Saskatchewan
MEMBERSHIPS	Member, Engineering Institute of Canada Member, Canadian Society for Civil Engineering Member, American Society of Civil Engineers

EXPERIENCE

1973 - date

Western Canada Hydraulic Laboratories Ltd., Vancouver, B.C.

Coastal and River Studies:
- Fraser River Model Studies - Steveston Boat Harbour
  River Training for 40' draft; Fraser Estuary Salinity Intrusion
- Fraser River Borrow Hole Migration
- Fitzsimmons Creek Flood Levels
- Alouette River Bridge Pier Erosion

Special Studies:
- Outfall design - Island Copper Mine, Port Hardy, B.C.; Anaconda Britannia Mines; Climax Molybdenum of B.C., Alice Arm, B.C.
- Jet Pumps for Fish Transport
- Automatic Fish Tub Washer
- Emergency Cooling Pump Intakes - Davis Besse Nuclear Power Plant; Detroit Edison Co.; J.M. Farley Nuclear Power Plant; Alabama Light & Power Co.

1966 - 1973

Saskatchewan Research Council
- Development of pipeline transportation technology of thermal and metallurgical coals, iron ores, potash, limestone, tailings sands and others for Canadian Industry sponsored by:
  - (a) Canadian Transport Commission, 3 year program
  - (b) Canadian National Railways, 4 months program
- Feasibility potash solids pipeline (2 1/2 years)
- Tarsands tailings pipeline for Syncrude Ltd.
- Copper concentrates by pipeline (Trimac)
- Helically ribbed pipes for sand transport (Dominion Gasket and Mfg. Co.)

1963 - 1966	Massachusetts Institute of Technology - Assistant, Research on sediment transport studies
1963	Underwood and McLellan & Associates - Construction of sewer and water facilities
1961	Stock, Keith & Associates - Grid road network in Saskatchewan
1954 - 1960	Saskatchewan Department of Highways - Engineering, design and construction of highways

March, 1978