



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

February 11, 1991

Docket No. 50-336

LICENSEE: Northeast Utilities
FACILITY: Millstone, Unit 2
SUBJECT: SUMMARY OF MEETING OF JANUARY 23, 1991, WITH REPRESENTATIVES
OF NORTHEAST UTILITIES CONCERNING THE PROGRAM FOR THE
REPLACEMENT OF STEAM GENERATORS FOR MILLSTONE 2 IN 1992

INTRODUCTION

On January 23, 1991, representatives of the NRC and Northeast Utilities met in the NRC offices in Rockville, Maryland to discuss the Millstone, Unit 2, steam generator replacement project. The attendance list is provided in Enclosure 1. Enclosure 2 provides the agenda and copies of the viewgraphs supporting the licensee's presentation. Not enclosed are the 35 mm slides of the fabrication of the the steam generators at Babcock & Wilcox, Canada, and the video that provided an overview of the project. The video will later be available to the staff for viewing as desired.

DISCUSSION

This was the second meeting with the staff on the steam generator replacement project. The licensee wants to keep the staff informed on the project through a series of meetings.

Babcock & Wilcox of Canada is doing the design and fabrication of the steam generators and Fluor Daniel, Inc. are the installers. Combustion Engineering is the NSSS and provides the original design specifications. American Nuclear Fuels is the fuel vendor and owns the accident analyses.

The replacement steam generators are technically considered a repair under the Section XI of the 1983 ASME Code and is being performed under the provisions of 10 CFR 50.59 on the basis of precedence set by other utilities' steam generator replacement programs. The 10 CFR 50.59 determination has not been completed and the licensee will submit a proposed amendment if the determination requires an amendment. The replacement scope is that portion of the steam generators that is below the mid-point of the the cone area. This is the area that includes the largest diameter that would pass through the containment access opening and which can be handled by the crane.

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PDR ADOCK 05000336
P PDR

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The steam generators will be delivered by barge to the plant site in May 1991 and installed in the containment during the refueling outage starting in March 1992.

The basis of the design is the design specifications of the original steam generators plus special requirements, improved material properties and improved design features. Improvements include features to provide for improved personnel safety, keeping exposures down as low as reasonably achievable, improved blowdown characteristics, larger manways, larger access openings, and improved nozzle dams. The licensee is taking advantage of lessons learned from other replacement projects and they have chosen their contractors on the bases of their extensive experience in steam generator work. The staff showed an interest in the experience of steam generators designed by B&W of Canada and the licensee will provide such detail information.

The 35 mm slide presentation of the fabrication provided a good view of the fabrication from beginning to end. The video presentation provided a very good overview of the total project with animated illustrations of the removal of the old steam generators and the installation of the new steam generators. The video will be available to the staff for viewing as desired. The licensee would look forward to another meeting with the staff in 4 to 6 weeks.

KS

Guy S. Vissing, Senior Project Manager
Project Directorate I-4
Division of Reactor Projects I/II

Enclosures:
As stated

cc w/enclosures:
See next page

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Millstone Nuclear Power Station
Unit No. 2

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ATTENDANCE LIST FOR
MEETING WITH NORTHEAST UTILITIES
CONCERNING
STEAM GENERATOR REPLACEMENT
AT
MILLSTONE 2
JANUARY 23, 1991

<u>Name</u>	<u>Organization</u>
Guy S. Vissing	NRR/PD I-4
John A. Rhodes	NUSCO/SGRP
John G. Resetar	NU/SGRP
Salvatore Orefice	NU/SGRP
Kris Parczewski	EMEB/DET/NRR
George Hubbard	NRR/DST/SPLB
B. D. Liaw	NRR/DET
Steve Jones	NRR/DST/SPLB
Matthew Guarini	Serch Licensing
C. Y. Cheng	NRR/DET/EMEB
Keith Wichman	NRR/DET/EMEB
Emmett Murphy	NRR/DET/EMEB
Harry Balukjian	NRR/DST/RSB
Ray Crawford	Fluor Daniel (observer)
Ray Necci	NU/Manager/SGRP
Bill Hutchins	NU/Licensing/MP2
Paul Blasioli	NU/Supervisor/Nuclear Lic.
Don Haverkamp	NRC/RI



MILLSTONE UNIT NO. 2
SG REPLACEMENT PROJECT MEETING
JANUARY 23, 1991

AGENDA

- o MEETING PURPOSE P. A. BLASIOLI

- o PROJECT OBJECTIVES R. P. NECCI

- o PROJECT BACKGROUND R. P. NECCI
VIDEO

- o PROJECT STATUS S. OREFICE
SLIDES

- o SUBASSEMBLY PROCUREMENT/DESIGN J. A. RHODES

- o MAINTENANCE FEATURES J. G. RESETAR

- o SUMMARY R. P. NECCI



**PROJECT
OBJECTIVES**

MP2 S/G REPLACEMENT PROJECT

January 23, 1991



PROJECT OBJECTIVES

- o HIGH-QUALITY/ZERO ERRORS
- o PERSONNEL SAFETY
- o EXPOSURE AS LOW AS REASONABLY ACHIEVABLE
- o DESIGN REVIEW PROCESS
- o OPEN COMMUNICATIONS

MP2 S/G REPLACEMENT PROJECT

January 23, 1991



**PROJECT
BACKGROUND**

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MAJOR MILESTONES

- o CONCEPTUAL STUDY 8/84
- o MK-FERGUSON STUDY 12/86
- o PROCURE TUBESHEETS 2/87
- o P.O. FOR NEW SGs 2/88
- o P.O. FOR ENGINEER CONSTRUCTOR 4/90
- o PREREPLACEMENT WORK 9/90
- o SG DELIVERY 5/91
- o REPLACEMENT ENGINEERING ONGOING

MP2 S/G REPLACEMENT PROJECT

January 23, 1991

MP2 SGRP

SGRP PROJECT TEAM

NORTHEAST UTILITIES

BABCOCK & WILCOX
CANADA

FLUOR DANIEL, INC.

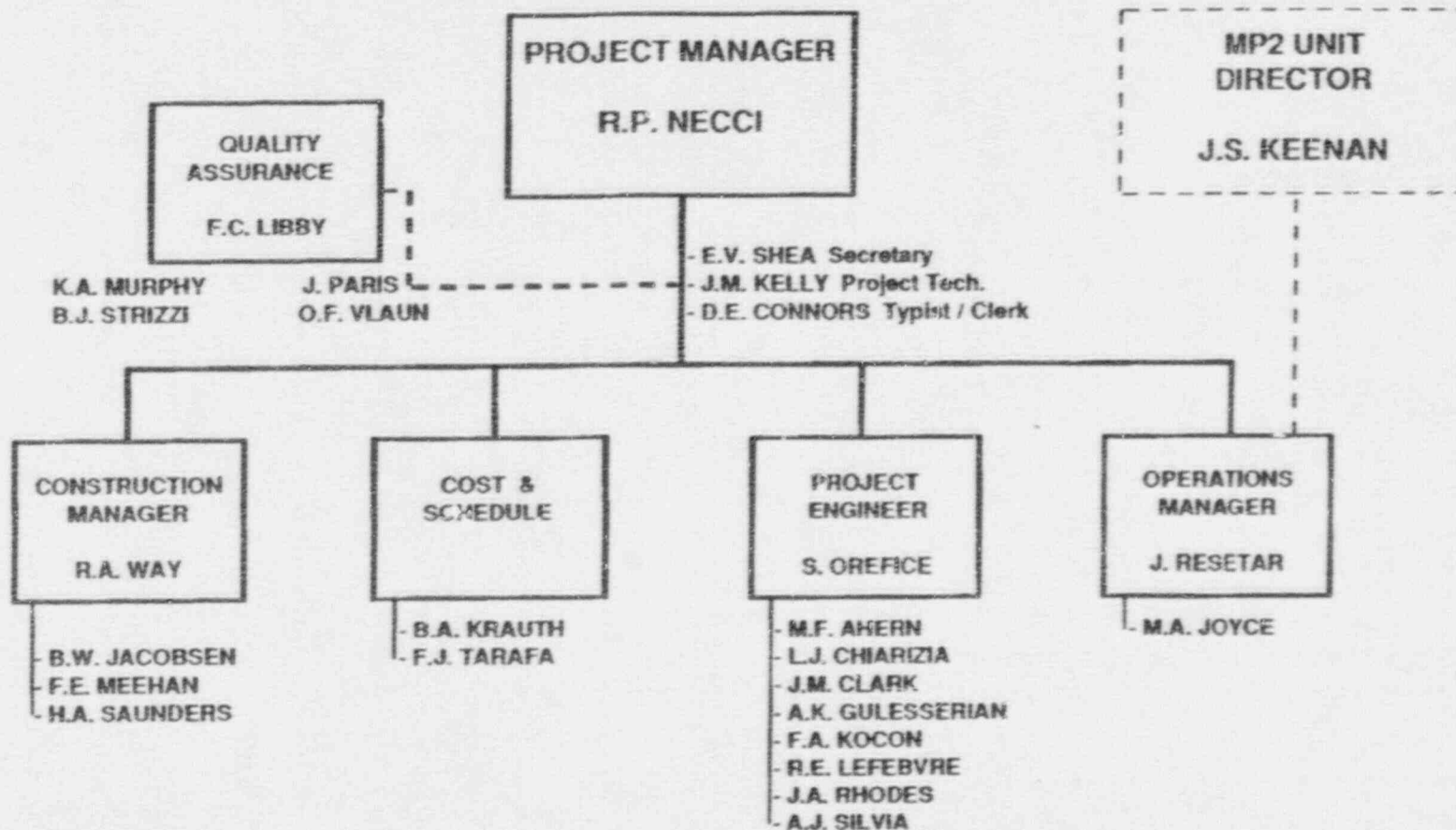
SPECIALTY
SUBCONTRACTORS

MP2 S/G REPLACEMENT PROJECT

January 23, 1991



MILLSTONE 2 STEAM GENERATOR REPLACEMENT PROJECT ORGANIZATION



MP2 S/G REPLACEMENT PROJECT

January 23, 1991

REPLACEMENT PHILOSOPHY

- o LESSONS LEARNED FROM REPLACEMENTS
- o EXPERIENCED VENDORS
- o INNOVATIVE TECHNOLOGY
- o EXTENSIVE TRAINING
- o CONTINGENCY PLANNING

LESSONS LEARNED

- o VISITS TO ACTUAL REPLACEMENTS
- o LOANED PERSONNEL TO PALISADES
- o USE OF PRIOR OUTAGES
- o POST REPLACEMENT VISITS TO SSPB/EDF



EXPERIENCED VENDORS

- o FLUOR DANIEL, INC.
 - DESIGNED OR CONSTRUCTED 10 NUCLEAR PLANTS
 - SURRY SGRP
 - #1 IN ENGINEERING NEWS RECORD
 - EXCELLENT SAFETY RECORD

- o BABCOCK & WILCOX CANADA
 - MANUFACTURED MORE THAN 200 SGs
 - SIMILAR DESIGN TO MILLSTONE 2
 - EXCELLENT RELIABILITY RECGRD



INNOVATIVE TECHNOLOGY

- o WELDING TECHNIQUE
- o CUTTING TOOLS
- o ALIGNMENT/MEASUREMENT PROCESS
- o ELECTRONIC DOSIMETRY

TRAINING

- o MOCK-UP AND TRAINING FACILITY
- o USE OF REAL CHANNEL HEAD AND PIPE
- o SIMULATE CONTAINMENT ENVIRONMENT



**PROJECT
STATUS**

MP2 S/G REPLACEMENT PROJECT
January 23, 1991

PROJECT STATUS

- o REPLACEMENT METHOD

- o SUMMARY SCHEDULE
 - 1990 SGRP ACCOMPLISHMENTS
 - 1991 SGRP ACTIVITIES

- o 1992 REPLACEMENT OUTAGE SCHEDULE

- o SGRP SUPPORT FACILITIES

- o SG DISPOSAL

- o DESIGN REVIEW PROCESS



REPLACEMENT METHOD

- o KEY CONSIDERATIONS
- o CUT STEAM DRUM AT CONE
- o NEW DRYERS AND SEPARATORS
- o CUT RCS PIPING
- o NO CONCRETE REMOVAL

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January 23, 1991



REPLACEMENT METHOD

- o UPGRADE POLAR CRANE

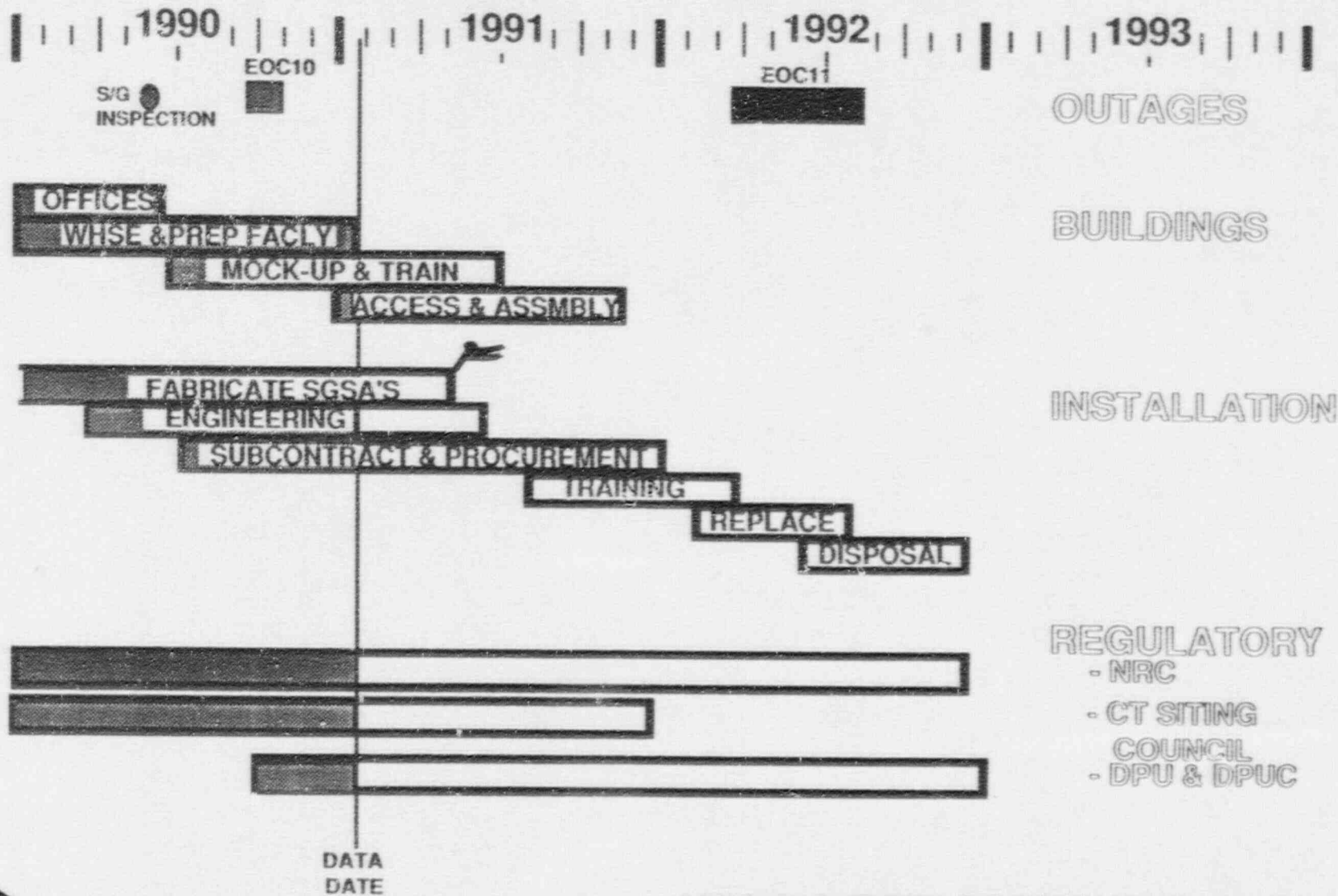
- o STRUCTURAL MODIFICATIONS

- o FUEL POOL COVER

- o INTERFERENCE REMOVAL AND RESTORATION



SUMMARY SCHEDULE



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1990 SG REPLACEMENT PROJECT ACCOMPLISHMENTS

- o **SGSA MANUFACTURE**
 - PRESSURE VESSELS COMPLETED
 - LATTICE RINGS INSTALLED
 - TUBING MANUFACTURED
 - UNITS TUBED
 - SEAL WELDING COMPLETED

- o **ENGINEERING/INSTALLATION**
 - INSTALLATION ENGINEERING WAS STARTED
 - INSTALLATION OF CONSTRUCTION TROLLEY
 - INSTALLATION OF FLOOR REINFORCEMENT
 - MEASUREMENTS OF STEAM DRUM INTERNALS
 - PHOTOGRAMMETRY/OPTICAL MEASUREMENT OF RCS PIPING
 - ENGINEERING/CONSTRUCTION WALKDOWNS
 - SITE PROJECT OFFICES COMPLETED
 - ERECTION OF SGSA STORAGE AND FABRICATION SHOP

MP2 S/G REPLACEMENT PROJECT

January 23, 1991

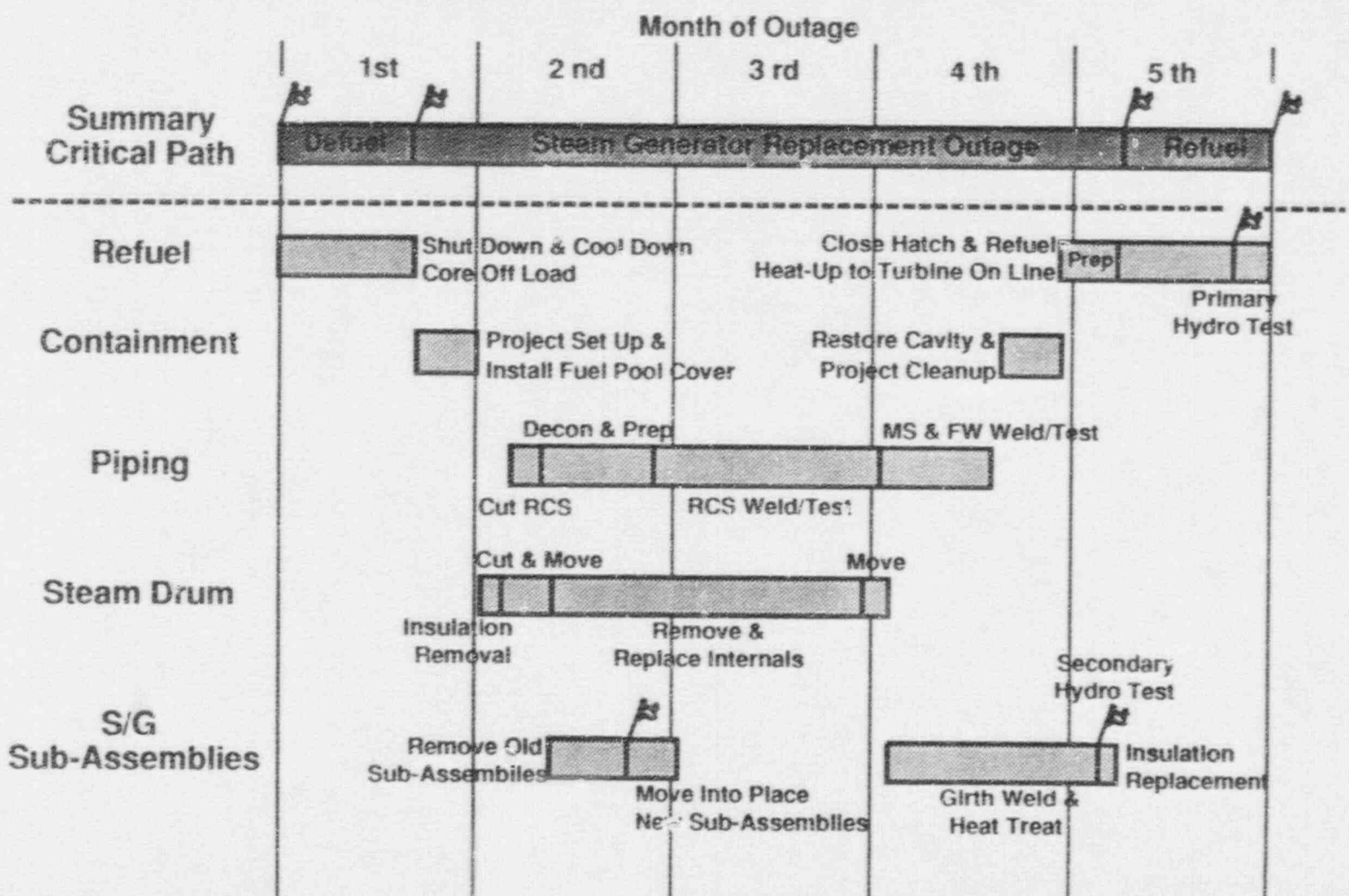
1991 SG REPLACEMENT PROJECT ACTIVITIES

- o SGSA MANUFACTURE
 - COMPLETE MANUFACTURING ACTIVITIES
 - DELIVERY TO SITE

- o ENGINEERING/INSTALLATION
 - COMPLETE INSTALLATION ENGINEERING
 - ISSUE CONTRACTS FOR SPECIALTY SERVICES
 - PROCURE ALL PARTS AND MATERIALS
 - DEVELOP WORK PROCEDURES
 - BEGIN TRAINING OF PERSONNEL
 - COMPLETE SUPPORT FACILITIES



MP2 S/G REPLACEMENT PROJECT 1992 Replacement Outage Schedule

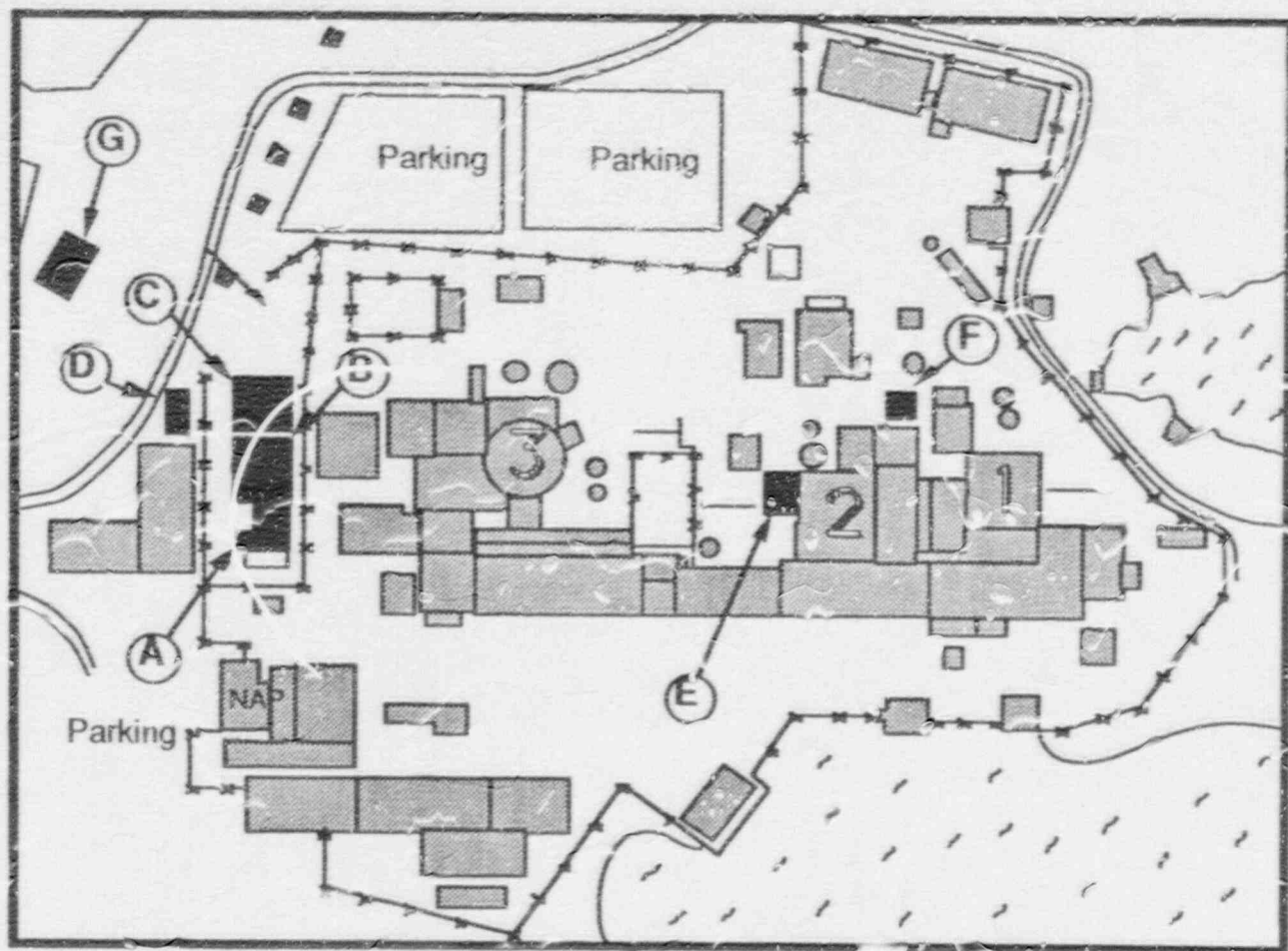


SG REPLACEMENT PROJECT SUPPORT FACILITIES

- o PROJECT OFFICES AT SITE (COMPLETED)
- o SGSA STORAGE AND FABRICATION SHOP (COMPLETED)
- o MOCK-UP AND TRAINING FACILITY (7/91)
- o CONTAINMENT ACCESS STRUCTURE (12/91)
- o CRAFT ASSEMBLY SUPPORT FACILITY (12/91)



MILLSTONE SITE



S/G Replacement Support Facilities

A=Offices B=Warehouse C=Prep. Facility D=Training Fac.
E=Containment Access Bldg. F=Craft Assembly Fac. G=I.S.F.

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SG DISPOSAL

- o RADIOACTIVE WASTES PROCESSED PER EXISTING PLANT PROCEDURES
- o ALL SG OPENINGS SECURED PRIOR TO REMOVAL
- o FIX OUTSIDE CONTAMINATION
- o PURSUING OFF-SITE DISPOSAL
- o ALTERNATE OPTION IS TEMPORARY ON-SITE STORAGE



DESIGN REVIEW PROCESS

- o SAFETY EVALUATIONS
 - UTILIZE EXISTING NU SAFETY EVALUATION PROCEDURES
 - INPUT/PREPARATION BY:
 - BABCOCK & WILCOX CANADA
 - ADVANCED NUCLEAR FUEL
 - ASEA BROWN BOVERI/COMBUSTION ENGINEERING
 - FLUOR DANIEL, INC.

- o NU WILL PERFORM THE INTEGRATED SAFETY EVALUATION

- o SAFETY EVALUATIONS HAVE BEEN STARTED

- o TO DATE, NO UNREVIEWED SAFETY QUESTIONS

- o NU PRELIMINARY ASSESSMENT: 10CFR50.59

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The logo consists of a stylized 'M' shape with a horizontal bar across its middle. The text 'MP2 S/G' is written inside the bar.

MP2 S/G

**SUBASSEMBLY
PROCUREMENT/DESIGN**

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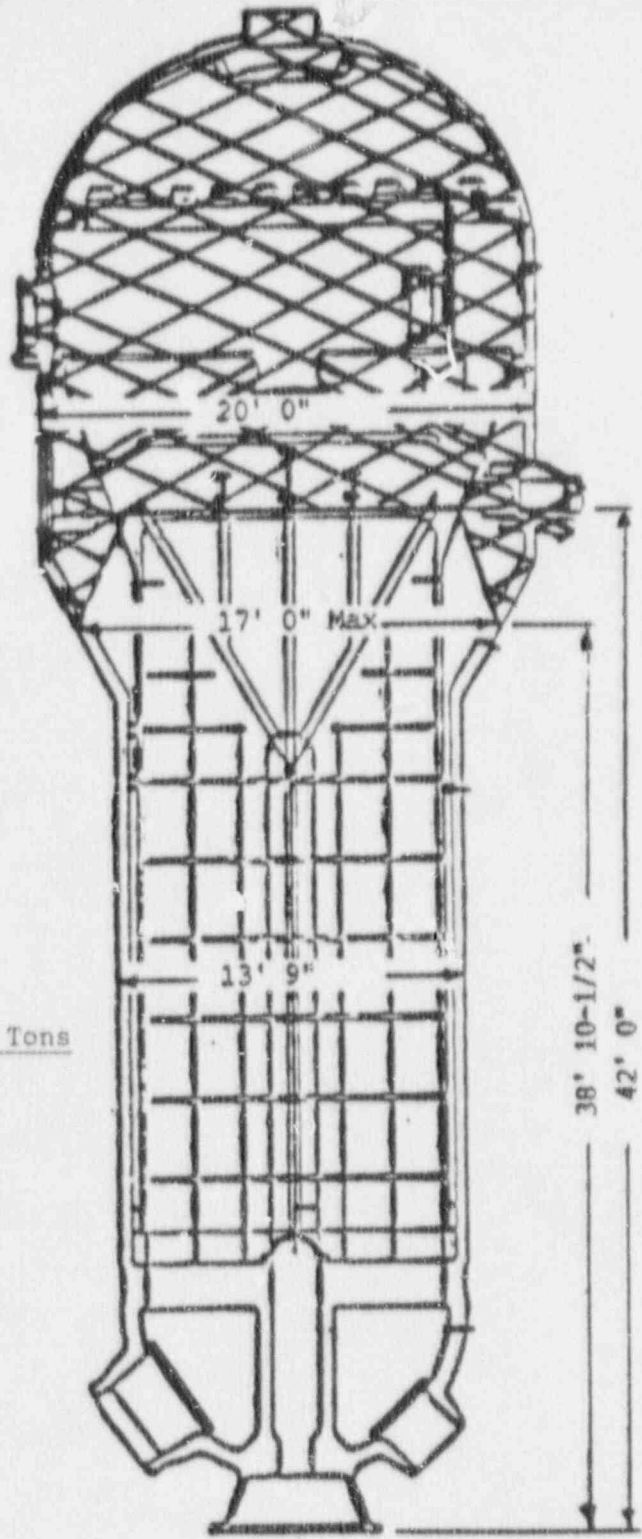
SGSA PROCUREMENT

- o BASIS TO PROCURE SGSAs

- o LONG LEAD TIME MATERIAL--TUBESHEETS

- o REPLACEMENT CONFIGURATION

- o DEVELOPMENT OF SGSA SPECIFICATIONS
 - ORIGINAL SPECIFICATION
 - EPRI RECOMMENDATIONS
 - 50.59 LIMITATIONS
 - ASME SECTION XI
 - MAINTENANCE AND OPERATIONAL FEEDBACK



Weight 325 Tons

Steam Generator Sub-Assembly
(SGSA)

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SELECTION OF BWC

- o BIDDER LIST
 - COMBUSTION ENGINEERING
 - KRAFTWERK UNION
 - BABCOCK & WILCOX CANADA
 - WESTINGHOUSE

- o KEY SELECTION CRITERIA
 - TECHNICAL
 - QUALITY
 - COMMERCIAL



QUALIFICATION OF BWC

- o TECHNICAL ABILITIES
- o NUSCO QA AUDIT
- o ASME "N" CERTIFICATE RECEIPT
- o ONGOING DOCUMENT TECHNICAL AND QA REVIEWS
- o QA RESIDENT



PROCUREMENT STATUS

o FABRICATION STATUS

- PRESSURE VESSELS COMPLETED
- TUBE BUNDLES ASSEMBLED
- TUBE SEAL WELDING COMPLETE
- HYDRAULIC EXPANSION IN PROGRESS
- HYDROSTATIC TESTING AND SHIPPING PREPARATION REMAINING

o TRANSPORTATION ROUTE

- RAIL FROM CAMBRIDGE, ONTARIO, TO PORT OF TORONTO, ONTARIO
- BARGE VIA ERIE CANAL AND HUDSON RIVER TO MILLSTONE BARGE SLIP
- HEAVY HAULER TO MILLSTONE SGRP FABRICATION SHOP

- o SGSAs TO BE PREPARED/STORED IN SGRP FABRICATION SHOP

SG DESIGN OBJECTIVES

- o MAINTAIN:
 - FLUID VOLUMES
 - PRESSURE VESSEL STRUCTURAL CHARACTERISTICS
 - THERMAL OUTPUT

- o IMPROVE:
 - TUBE BUNDLE RELIABILITY
 - REDUCE PERSONNEL RADIATION EXPOSURE
 - OPERABILITY

COMPARISON OF SG DESIGNS

<u>TYPE</u>	<u>ORIGINAL SPECIFICATION (STRETCH POWER)</u>	<u>REPLACEMENT SPECIFICATION</u>
	<u>COMBUSTION ENGINEERING SERIES 6/</u>	<u>BABCOCK & WILCOX CANADA ADVANCED PWR RECIRCULATING</u>
THERMAL HYDRAULICS		
o PRIMARY FLOW RATE	74 x 10 ⁶ LBS/HR	74 x 10 ⁶ LBS/HR
o MOISTURE CARRYOVER	0.25%	0.20%
o PRIMARY INLET TEMP.	594 ^o F	594 ^o F
o PRIMARY OUTLET TEMP.	544 ^o F	544 ^o F
o HEAT TRANSFER RATE	4.63 x 10 ⁹ BTU/HR	4.63 x 10 ⁹ BTU/HR
o FEEDWATER FLOW RATE	5.9 x 10 ⁶ LBS/HR	5.9 x 10 ⁶ LBS/HR
o STEAM PRESSURE	880 PSIA	880 PSIA
TUBE BUNDLE PARAMETERS		
o TYPE	U-BEND FLAT TOP	U-BEND SPHERICAL TOP
o TUBE DIAMETER	0.75"	0.75"
o TUBES PER GENERATOR	8519	8523
o TUBE WALL THICKNESS	0.048"	0.045"
o PITCH PATTERN	1.0" TRIANGULAR	1.0" TRIANGULAR
o HEAT TRANSFER AREA	90,600 FT ²	93,500 FT ²
o TUBE MATERIAL	I600	I690 TT
o SUPPORTS	EGGCRATE (LATTICE BARS) CARBON STEEL	LATTICE BARS STAINLESS STEEL
PHYSICAL SIZE		
o FLOODED WEIGHT (LB)	1,603,000	1,648,000
o PRIMARY VOLUME (FT ³)	1638 (EST.)	1692
o SECONDARY VOLUME (FT ³)	7887 (EST.)	7662

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**DESIGN OBJECTIVE FOR IMPROVING
TUBE BUNDLE RELIABILITY**

- o SELECTION OF COMPATIBLE HIGHLY CORROSION-RESISTANT TUBE AND SUPPORT MATERIALS

- o TUBE BUNDLE DESIGN WHICH AVOIDS TUBE VIBRATION AND MINIMIZES SLUDGE DEPOSITION

MATERIAL SELECTION

o TUBING

-- SELECTION BASED ON:

- HIGHER CORROSION RESISTANCE OVERALL TO THE VARIOUS FORMS OF ATTACK
- CURRENT U.S. INDUSTRY STANDARD FOR REPLACEMENT DESIGNS
- RECOMMENDED BY EPRI

-- THERMALLY TREATED ALLOY 690 (EXISTING-- MILL ANNEALED ALLOY 600)

- 1976^oF MINIMUM ANNEALING TEMPERATURE
- 1292^oF THERMAL TREATMENT
- C% \leq 0.025



MATERIAL SELECTION

- o TUBE SUPPORTS
 - SELECTION BASED ON:
 - HIGHER CORROSION RESISTANCE
 - LOW TUBE WEAR POTENTIAL
 - STRENGTH

 - TEMPERED MARTENSITIC STAINLESS STEEL--
MODIFIED 410S (EXISTING--CARBON STEEL)



DESIGN OBJECTIVE FOR IMPROVING TUBE BUNDLE RELIABILITY

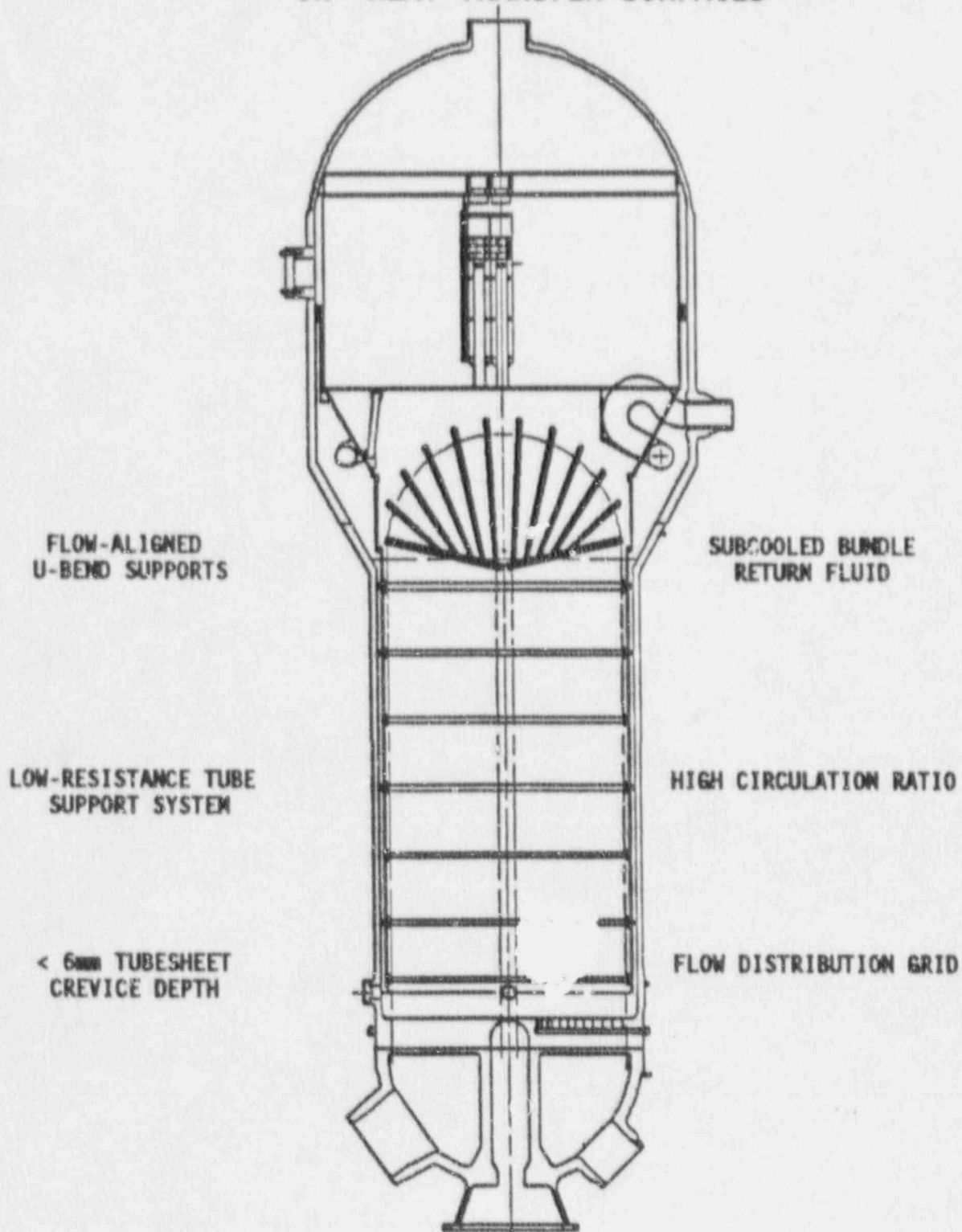
- o SELECTION OF COMPATIBLE HIGHLY CORROSION-RESISTANT TUBE AND SUPPORT MATERIALS

- o TUBE BUNDLE DESIGN WHICH AVOIDS TUBE VIBRATION AND MINIMIZES SLUDGE DEPOSITION
 - HIGH SECONDARY-SIDE CIRCULATION
 - TUBE BUNDLE SUPPORT SYSTEM TO ACCOMMODATE HIGH CIRCULATION
 - TUBE AND SUPPORT PROCESSING CONTROLS
 - SECONDARY SIDE CHEMISTRY CONTROL FEATURES

MP2 S/G

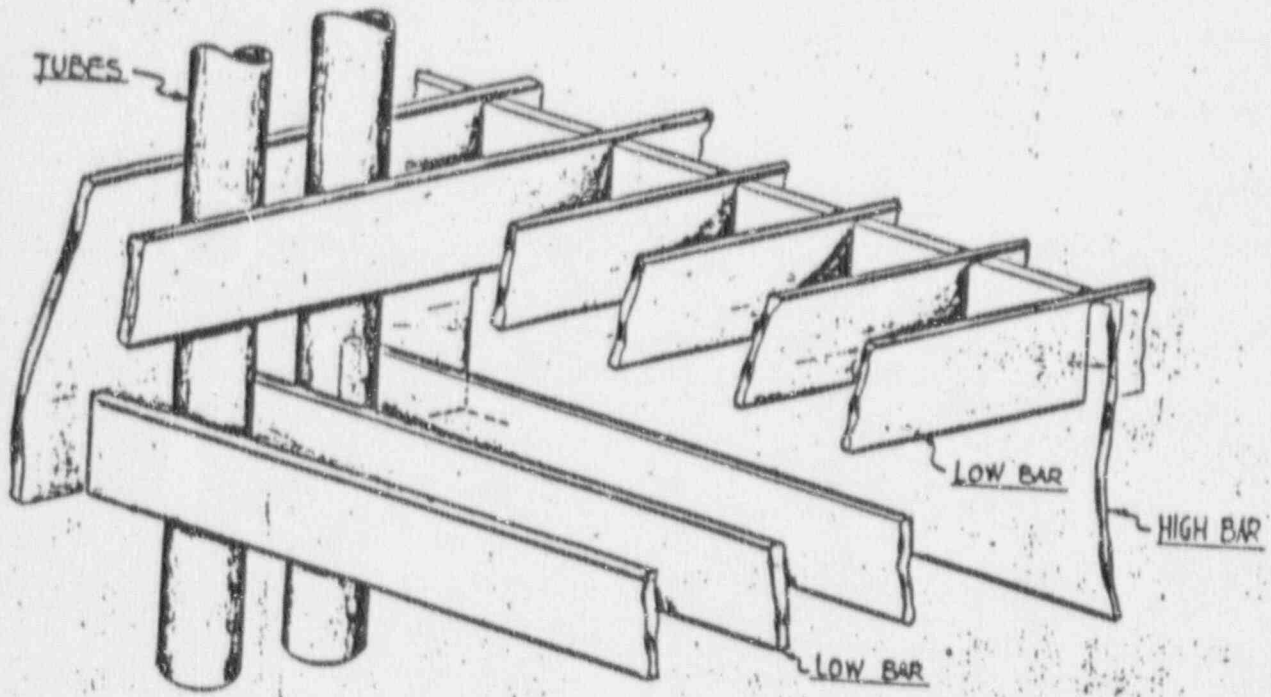
HIGH SECONDARY-SIDE CIRCULATION

OBJECT: AVOID CHEMICAL HIDEOUT OR DRYOUT
ON HEAT TRANSFER SURFACES



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TYPICAL ASSEMBLY

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TUBE BUNDLE VIBRATION

OBJECTIVE: UTILIZE A SUPPORT SYSTEM WHICH CAN BE DEMONSTRATED BY ANALYSIS THAT SUFFICIENT MARGINS EXIST TO AVOID VIBRATION

- o MINIMIZE TUBE-TO-TUBE SUPPORT CLEARANCES
- o MINIMIZE TUBE SPANS IN BUNDLE AND U-BEND REGION
- o AVOID HIGH FLUID RESISTANCE OR FLUID CHANNELING
- o QUALIFICATION OF SUPPORT SYSTEM ASSUMING AN INEFFECTIVE SUPPORT

MATERIAL CONTROL

OBJECTIVE: AVOID CONTAMINATION OR INTRODUCTION OF SIGNIFICANT RESIDUAL STRESSES IN CORROSION-RESISTANT MATERIALS (I.E., TUBING, TUBE SUPPORTS, CLADDING) DURING MANUFACTURE OF SGs

- o CONTAMINATION CONTROL PROCEDURE:
 - PROCEDURES AND ANALYSIS TO MINIMIZE CONTACT WITH HALIDES, SULFATES AND PROHIBIT CONTACT WITH LOW MELTING POINT METALS
 - FINAL CLEANING CONTROLS

- o MINIMIZATION OF RESIDUAL STRESSES AT:
 - U-BENDS FIRST 8 ROWS STRESS RELIEVED (U-BEND RADIUS/TUBE DIAMETER < 9)
 - FULL-LENGTH TUBE-TO-TUBESHEET EXPANSION



SECONDARY-SIDE CHEMISTRY CONTROL

OBJECTIVE: IMPROVE ABILITY TO CONTROL CHEMISTRY

- o INCREASED BLOWDOWN CAPABILITY

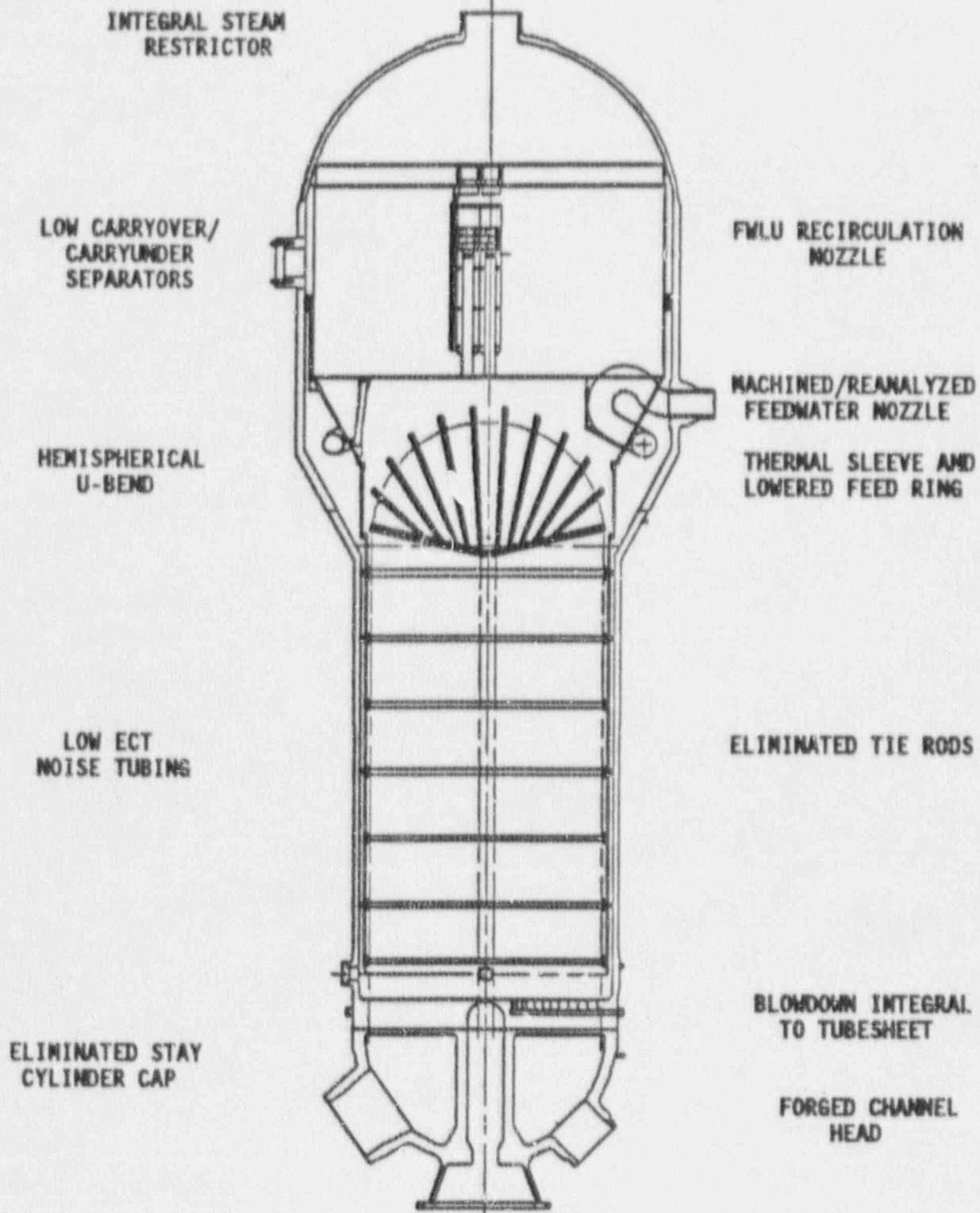
- o INTEGRAL COLD SHUTDOWN RECIRCULATION SYSTEM
(ONE VOLUME TURNOVER/8 HOURS)

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IMPROVEMENTS



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CONCLUSIONS

- o CRITERIA OF 10CFR50.59 APPEAR TO BE ACHIEVABLE

- o ALL FEATURES WHICH COULD IMPROVE RELIABILITY HAVE BEEN INCORPORATED

- o THE HIGHEST QUALITY STANDARDS WERE ACHIEVED THROUGHOUT THE FABRICATION OF THE SUBASSEMBLIES



MAINTENANCE FEATURES

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MODIFICATION INPUTS

- o INDUSTRY EXPERIENCE

- o ALARA IMPROVEMENTS

- o WORKER INPUT

- o CHEMISTRY CONTROL NEEDS

- o RELIABILITY CONSIDERATIONS

MP2 S/G

IMPROVED OPERABILITY AND MAINTENANCE FEATURES

INTEGRAL STEAM RESTRICTOR

IMPROVED STEAM
SEPARATION
EQUIPMENT

LOWERED
FEEDWATER RING

FEEDWATER NOZZLE
AND PIPE
THERMAL SLEEVE

LOW COBALT TUBING
(0.015%) AND
CLADDING (0.1%)

WIDE-RANGE WATER
LEVEL INDICATOR

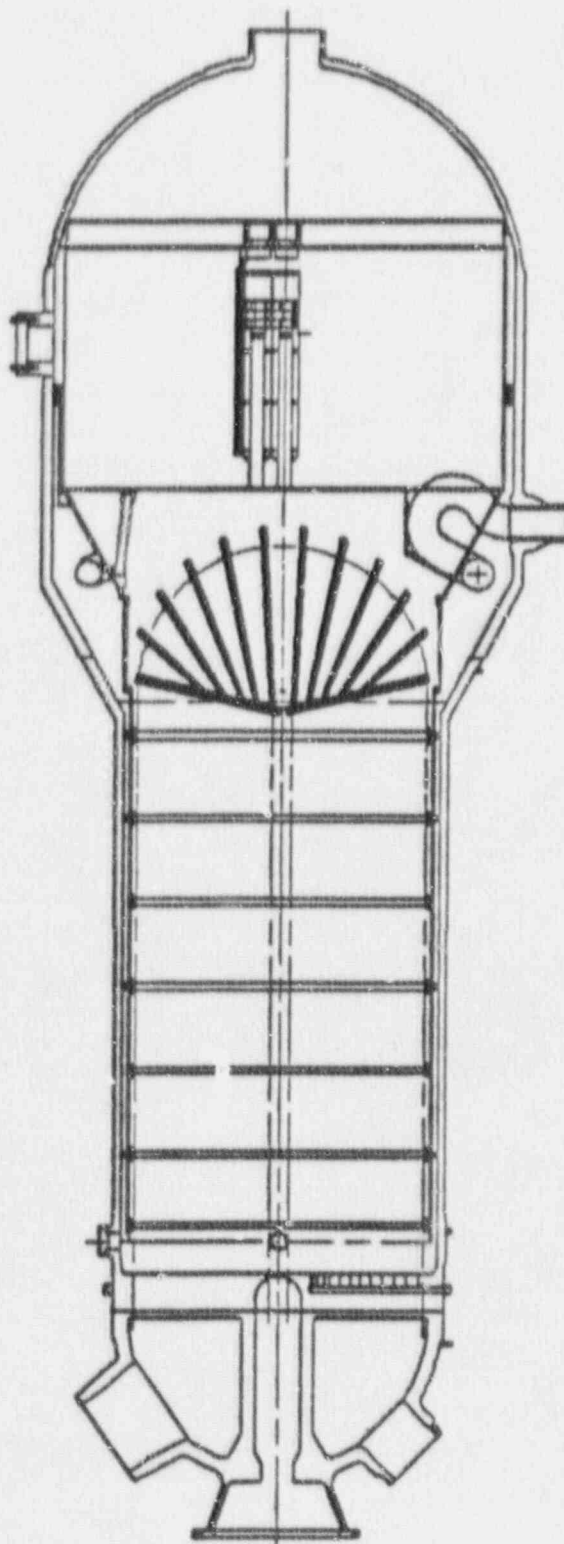
HIGH-CAPACITY
BLOWDOWN (7%)

ENLARGED HANDHOLES
AND MANWAYS

TUBESHEET MARKING

SECONDARY SHELL
DRAIN

POLISHED CLADDING



MP2 S/G REPLACEMENT PROJECT

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MAINTENANCE IMPROVEMENTS

- o BLOWDOWN MODIFICATIONS
- o PRIMARY MANWAYS
- o SECONDARY HANDHOLES
- o NOZZLE DAMS
- o WET LAY-UP RECIRCULATION
- o TUBESHEET MARKINGS

BLOWDOWN MODIFICATIONS

- o LARGER PIPE SIZE
- o DRAIN RELOCATION
- o HIGHER CAPACITY (FUTURE)

PRIMARY MANWAY

- o LARGER SIZE
- o RELOCATED IN BOWL
- o NEW HANDLING DEVICE
- o EXPOSURE SAVINGS

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SECONDARY HANDHOLES

- o INCREASED SIZE
- o INCREASED NUMBER
- o EXPOSURE SAVINGS

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NOZZLE DAMS

- o SINGLE DESIGN
- o ELIMINATE ALIGNMENT
- o POSITIVE VERIFICATION
- o EXPOSURE SAVINGS

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WET LAY-UP RECIRCULATION

- o EXTERNAL PIPING
- o EASIER INSTALLATION
- o CHEMISTRY CONTROL IMPROVEMENTS
- o ELIMINATE ENCLOSED VOLUME ENTRIES
- o EXPOSURE SAVINGS

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TUBESHEET MARKINGS

- o ELIMINATES TEMPLATES
- o EASIER TUBE IDENTIFICATION
- o EXPOSURE SAVINGS

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OTHER IMPROVEMENTS

- o WIDE-RANGE LEVEL INSTRUMENTATION

- o NEW DRYERS AND SEPARATORS

- o STAGING MODIFICATIONS

- o SHIELDING MODIFICATIONS



EXPOSURE SAVINGS SUMMARY

- o PRIMARY MANWAY RELOCATION
- o PRIMARY MANWAY HANDLING
- o NOZZLE DAMS
- o SECONDARY-SIDE DRAINS
- o SECONDARY HANDHOLES
- o STAGING MODIFICATIONS
- o WET LAY-UP RECIRCULATION
- o MATERIAL SELECTION
- o SURFACE PREPARATIONS

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January 23, 1991



POST SHUTDOWN EXPOSURE REDUCTIONS

- o LOW COBALT TUBING AND CLADDING

- o MECHANICAL POLISHING

- o ELECTROPOLISHING

MP2 S/G

SUMMARY

MP2 S/G REPLACEMENT PROJECT

January 23, 1991



SUMMARY

- o AMBITIOUS GOALS

- o DESIGN CHANGE PROCESS

- o OPEN COMMUNICATIONS

MP2 S/G REPLACEMENT PROJECT

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