NOV 15 1990

SGTB:NLO
50-322

MEMORANDUM FOR: The Files

FROM: Nancy L. Osgood, SGTB, SGTR, NMSS

SUBJECT: SUMMARY OF TELEPHONE CONFERENCE CALL REGARDING TRANSPORTING SHOREHAM REACTOR PRESSURE VESSEL

Participants

NRC	LILCo	Stone & Webster
Stewart Brown (part time)	Sheldon Schreiner	Jim Powers
Marissa Garcia	Gary Gisonda	Jerry Liu
Henry Lee		George East
Nancy Osgood	NYPA	
Li Yang	Siva Kumar	
	Fred Shar	

Introduction

A telephone conference call was held on November 7, 1990, at the request of Long Island Lighting Co. (LILCo), to discuss transporting the Shoreham reactor pressure vessel (RPV). LILCo stated that they were exploring several options for removing the RPV from the plant. One option was to remove the RPV whole and to transport it intact to a disposal site. To further evaluate this option, LILCo was requesting that the NRC Transportation Branch discuss the requirements that apply to qualifying the reactor vessel as a radioactive materials transport package. It was emphasized that no decision had yet been made on the disposition of the RPV.

Discussion

The discussion centered on the attached handout. The handout was transmitted by facsimile to NRC staff on November 6, 1990.

1. Package Description

The fuel has been removed from the RPV. Other components which may have high concentrations of radioactivity may also be removed. Most reactor internals would remain in the vessel. The head would be removed from the vessel, and a cover plate bolted over the vessel opening. Other nozzles would be cut off close to the vessel, and would also have cover plates. The head would not be part of the package. Pipes acting as an impact limiter would be used in some areas around the vessel. The vessel dimensions are approximately 20 feet in diameter by 67 feet long. The vessel wall thickness is approximately 5.5 to 6.5 inches. The total package weight is estimated at 800 tons.

F01
1/1

2. Radioactivity

The estimate of radioactivity is included in the handout. The estimates indicate that the vessel and its internals may qualify as low specific activity radioactive material. It was suggested that if an application is submitted, that the neutron flux levels and neutron energy spectrum be described in the application, and that benchmarking radiation measurements be reported. Sufficient information should be provided so that NRC staff can perform independent verification calculations of radioactivity and radioactivity concentration.

3. Structural Evaluation

The structural issues discussed are included in the handout. The structural analyses would consider two oblique drops at shallow angles. One drop would look at impact at the vessel flange, and one at the bottom head. Some type of impact limiters will be used. The current concept is to place pipes at particular points to absorb impact energy. Impact limiters would also be used to prevent nozzle stubs from direct impact. NRC staff stated that force-deformation information would be required for any impact limiters. NRC staff recommended that elastic analysis be used for drops. Load combinations should include stresses due to impact, pressure and thermal loads. NRC staff stated that fracture toughness of the package should be inherent in the material. NRC staff stated that it will not be necessary to evaluate crack initiation and propagation if the material itself can be shown to have adequate fracture toughness. Operational controls, such as confining the shipment to summer months, could possibly be considered in the evaluation of fracture toughness in extremely low temperatures.

Original Signed by

Nancy L. Osgood
Transportation Branch
Division of Safeguards and
Transportation, NMSS

Attachment: Handout

DISTRIBUTION:

NRC File Center	Participants - w/out att.
NRC PDR	Meeting Notebook - w/out att.
NMSS r/f - w/out att.	CRChappell - w/out att.
SGTB r/f - w/out att.	CEMacDonald - w/out att.

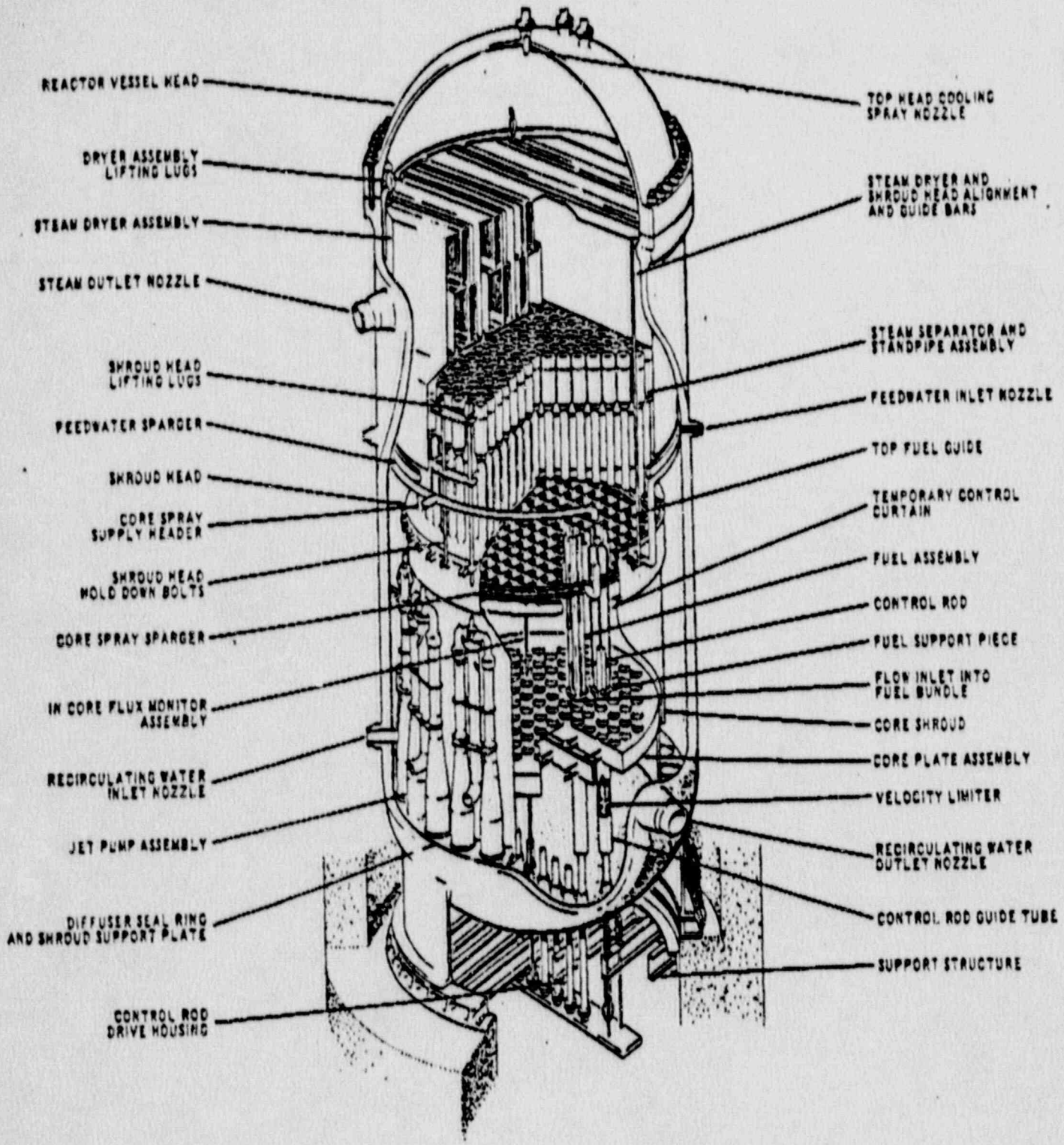
OFC	:SGTB	:SGTB
NAME	:NLOsgood	:CRChappell
DATE	:11/14/90	:11/15/90

OFFICIAL RECORD COPY

SHOREHAM NUCLEAR POWER STATION
UNIT 1

RPV SHIPPING PACKAGE

LONG ISLAND LIGHTING COMPANY



TYPICAL BOILING WATER REACTOR
WITH JET PUMPS

COMPONENTS REMOVED BEFORE SHIPMENT

RPV Head
Fuel
Control Rod Blades
Control Rod Drives
Fuel Support Castings
Low Power Range Monitors
Intermediate Range Monitors
Source Range Monitors
Antimony Pins
Beryllium Sleeves
Californium
Blade Guides
Traversing Incore Probe

RPV INTERNALS IN PACKAGE

Steam Dryer
Steam Separator
Shroud
Top fuel guide
Core Plate
Jet Pumps
CRD Guide Tubes
Internal piping (Spargers, etc.)
Instrument dry tubes

REACTOR ACTIVATION ANALYSIS RESULTS

		Reactor Internals Average Specific Activity [mCi/gm]					
Isotope	A_2	Top Fuel Guide	Core Shroud	Jet Pumps	Core Support	Vessel Clad	Inner 1/2 Vessel Wall
^{55}Fe	1000	1.73E-01	7.39E-03	9.27E-04	3.86E-03	2.74E-05	4.69E-06
^{60}Co	7	9.57E-02	2.95E-03	3.70E-04	2.14E-03	1.10E-05	1.64E-07
^{63}Ni	100	5.55E-03	2.43E-04	3.05E-05	1.24E-04	9.02E-07	6.12E-09
^{54}Mn	20	6.97E-03	0.00	0.00	1.56E-04	0.00	1.91E-07
^{59}Ni	900	4.05E-05	1.76E-06	2.21E-07	9.06E-07	6.54E-09	4.44E-11
Totals	-	2.81E-01	1.06E-02	1.33E-03	6.28E-03	3.93E-05	5.06E-06

Allowable concentration for LSA is 3.00E-01 mCi/gm

ESTIMATED RADIONUCLIDE INVENTORY IN THE RPV AND INTERNALS[1]

Component	Activity, Curies[2]							
	^{3}H	^{14}C	^{55}Fe	^{60}Co	^{63}Ni	^{59}Ni	Others[3]	Total Curies
Core Shroud	0.0381	0.0043	118.6620	47.3915	0.0283	3.9020	-	170.0263
Jet Pumps	0.0018	0.0002	5.5189	2.2041	0.0013	0.1815	-	7.9077
Top Guide Plate	0.0744	0.0084	232.1502	93.6200	0.0553	7.6298	0.2349	333.7731
Core Support	0.0017	0.0002	5.2119	2.0816	0.0012	0.1714	-	7.4680
Spray Header	-	-	0.0010	0.0004	-	-	-	0.0015
SRM/IRM Dry Tubes	-	0.0023	50.7000	21.4000	0.0107	1.55	1.7600	75.4230
CRD Guide Tubes	-	0.0002	3.9600	1.6800	0.0008	0.121	0.1370	5.9000
Vessel Cladding	-	-	0.0921	0.0368	-	0.0030	-	0.1319
Vessel Wall	0.0002	-	0.3272	0.0114	-	0.0004	0.0133	0.3525
Total by Isotope	0.1162	0.0156	416.6235	168.4257	0.0977	13.5592	2.1452	600.4830
Percent of total	0.02%	0.00%	69.32%	28.03%	0.02%	2.26%	0.36%	

1) Calculated neutron iduced activities as of July 1990.

2) The activities of the core shroud, top guide plate, SRM/IRM dry tubes, and CRD guide tubes have been normalized to exposure rate measurements. Normalization has not been performed for any other component.

3) Includes ^{54}Mn for the dry tubes and guide tubes. For other components, include isotopes with less than 0.01% contribution to total activity.

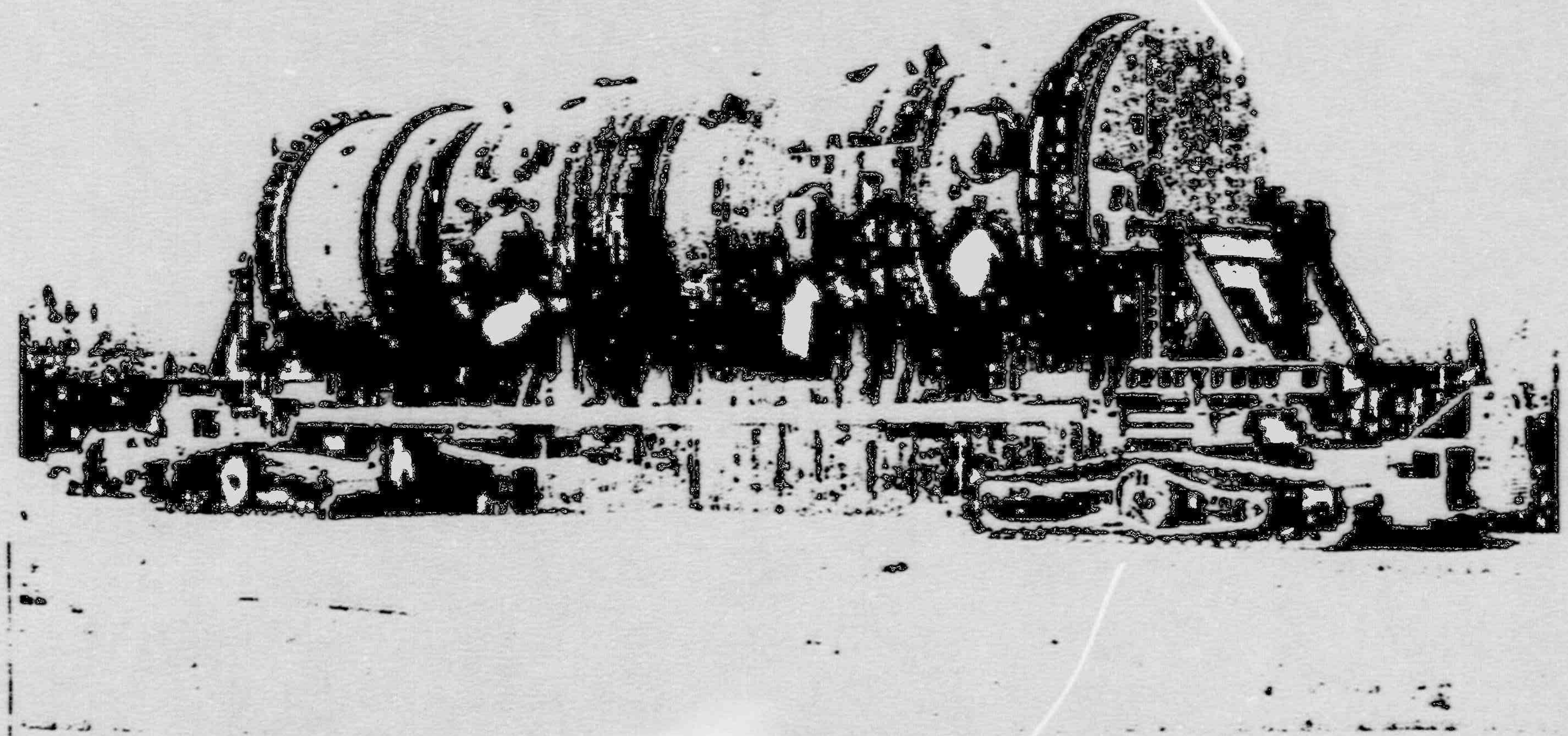
PREPARATION FOR SHIPMENT

Remove specified components
Cut-back nozzles (piping & CRD)
Plug and shield nozzles
Add cribbing to support shroud
Add closure plate at top of RPV
Attach lifting rig
Lift and lower
Attach upender (outside containment)
Add impact limiters (Selected areas)

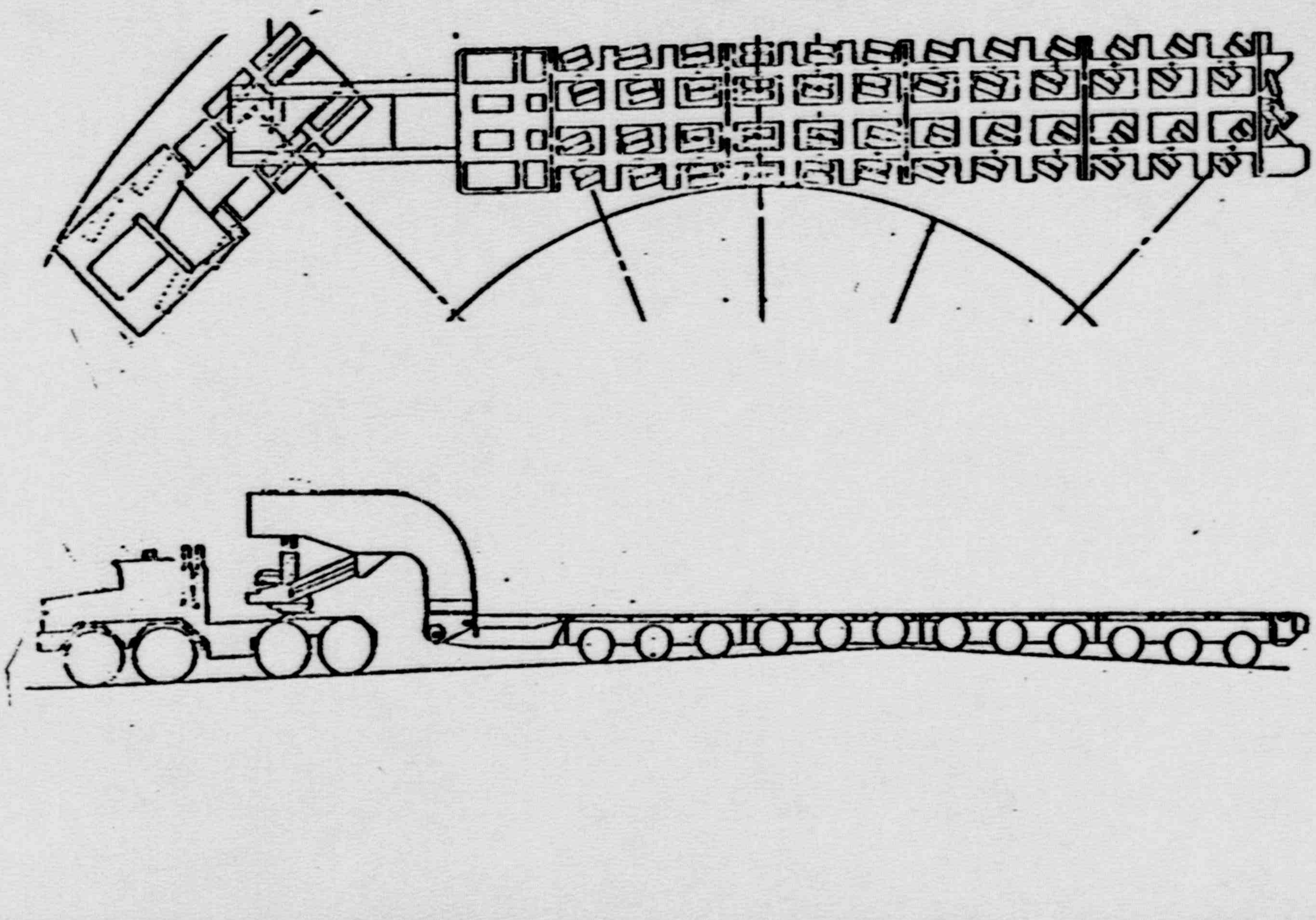
STEPS IN TRANSPORTING SHOREHAM RPV

Seal Package
Lift from containment
Attach upender
Up-end to horizontal position
Add impact limiters
Transfer to land transporter
Travel on site to dock
Transfer to barge
Barge transport to near burial site
Transfer to land transporter
Travel on public roads at very low speed
Transfer for burial

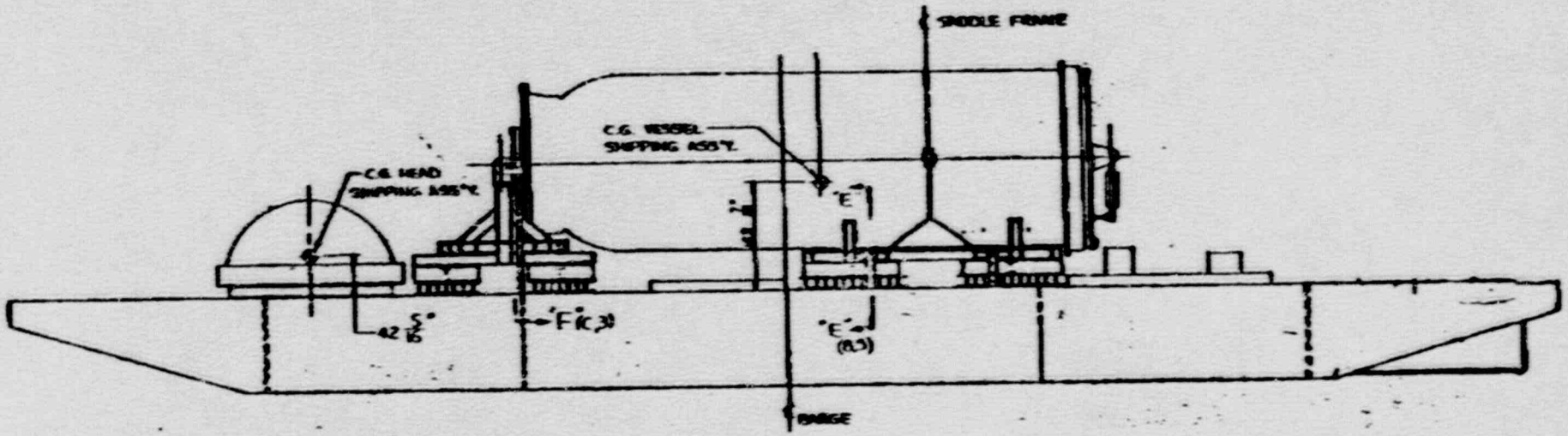
LAND TRANSPORTER (TYPICAL)



LAND TRANSPORTER (TYPICAL)



BARGE (TYPICAL)



PACKAGE EVALUATION

LSA package

Lifting

- Evaluate vessel (Initial lift, subsequent jacking)
- Evaluate attachments
  - Lift rig to RPV flange bolt circle
  - Upender to RPV skirt
- Consider limiting orientations
- Stresses < 1/3 yield

Tie-Down

- Saddle supports, strap, and upender
- No structural attachment to vessel except skirt
- 10g axial load on vessel produces low stress in skirt
- In case of excessive load, skirt will fail w/o impairing vessel

Transport

- Described in detail on subsequent pages

TRANSPORT LOADS

Deadweight

Tie-down strap tension

Thermal

- Uneven solar heating @ 100°F ambient
- Sudden temperature drop (-20°F to -40°F)

Pressure

- 11.2 psig internal, 5.3 psig external

Vibration/Shock

- Considered negligible due to low transport speeds

Drop impact (1 foot)

- Side Impact, two cases (Top closure, lower vessel)

Penetration

- 1-1/4 diameter, 13 lb. mass dropped through 40 in.

ACCEPTANCE CRITERIA

ASME analysis criteria will be used for convenience

Deadweight, strap-tension, thermal, pressure

- Stress intensity less than ASME III Service Level A

Drop Impact

- Plastic deformation of impact limiters and vessel
- No breach of vessel boundary
- Meet ASME Appendix F

Penetration

- Meet BRL formula

METHODS OF EVALUATION

Manual Evaluation

- Pressure per ASME rules (Vessel, closure plates, nozzle reinforcement)
- Strap tension
- Penetration

Finite Element Evaluation

- Deadweight
- Pressure
- Thermal
- Drop Impact

Load Combinations

- Deadweight + Pressure + Thermal
- Impact

BRITTLE FRACTURE PREVENTION

- Linear-elastic and elastic-plastic fracture mechanics
  - Similar to NUREG/CR-3826
- Review fracture toughness data or requirements
- Review NDE data to establish flaw size
- Envelop transport loads (including drop)
- Evaluate crack initiation
- Evaluate crack propagation