



**GPU Nuclear Corporation**

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July 20, 1992  
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U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, D.C. 20555

Dear Sir:

Subject: Oyster Creek Nuclear Generating Station (OCNGS)  
Operating License No. DPR-16  
Docket No. 50-219

Three Mile Island Nuclear Station, Unit 1 (TMI-1)  
Operating License No. DPR-50  
Docket No. 50-289  
Survey of Deterioration and Repair of Concrete  
In Nuclear Power Facilities

In response to the NRC's letter to GPUN, dated March 11, 1992 (C311-92-3046), regarding survey of deterioration and repair of concrete in nuclear power facilities, enclosed are completed survey forms for TMI-1 and OCNGS. This information is provided to assist in NRC development of a concrete repair manual for concrete structures in nuclear power plants, as part of its Nuclear Plant Aging Program.

The completed survey forms are based on reviews of plant records and discussions with appropriate personnel. This information has not been compiled in accordance with any quality assurance program activity and as such should be utilized for statistical survey purposes only.

If any additional information is needed, please contact Mr. David Distel at (201) 316-7955.

Very truly yours,

J. C. DeVine, Jr.  
Vice President and Director,  
Technical Functions

JCD/DJD/amk  
Enclosures

cc: A. Dromerick - USNRC  
R. Hernan - USNRC  
P. D. Krauss - Wiss, Janney, Elstner Associates, Inc.  
Administrator, Region I

32192175.let

9207280104 920720  
PDR ADOCK 05000219  
P PDR

GPU Nuclear Corporation is a subsidiary of General Public Utilities Corporation

ADD 11



**External Assistance**

Do you use outside consultants for inspection of concrete structures?

Yes  No

If yes:

Consultant Name

WATER FRONT INC	CEC	MUENOW ASS.
STEVE HILDEBRAND	JOE ATUSSO	RICHARD MUENOW
215-426-2345	412-238-2755	704-377-4041
		704-542-1471

Contact Name

Phone No.

Fax No.

Do you use outside consultants for repair of concrete structures?

Yes  No

If yes:

Company Name

Contact Name

Telephone No.

Fax No.

**General**

Do you conduct regular inspections of the concrete in the plant?

Yes  No

If yes:

How often do you conduct these surveys? IN GENERAL, THERE IS NO REGULAR SCHEDULE FOR CONCRETE INSPECTION. HOWEVER IN SOME AREA, CONCRETE INSPECTION IS PERFORMED DURING OUTAGE.

If yes:

What techniques are used to inspect the concrete condition?

- visual Yes  No
- half-cell potential tests for corrosion Yes  No
- removal of cores Yes  No
- NDT (pulse velocity, pulse echo, acoustic emission) Yes  No
- chemical analyses Yes  No
- X-ray Yes  No

FOR BLOCK WALL MORTAR  
 INTAKE CONCRETE STRUCTURE

other (describe) \_\_\_\_\_

### Observed Deterioration

Have you experienced damaged concrete in this plant? Yes  No

Have the following types of deterioration been located at the plant?

voids/honeycomb	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
cracking	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
scaling	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
spalling	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
staining	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
corrosion of reinforcing steel	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
degradation of prestressing steel	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
popouts	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
efflorescence	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
dusting	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
delamination	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>

other (please describe) \_\_\_\_\_

### Deterioration Mechanisms

Have you experienced concrete damage due to:

freeze/thaw	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
aggressive chemical attack	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
sulfate attack	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
seawater exposure	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
acid attack	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
abrasion	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
impact	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
corrosion of steel embedded in concrete	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
carbonation	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
corrosion of other metals embedded in concrete	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>

if yes, describe \_\_\_\_\_

chemical reactions of aggregates	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
dimensional changes				
thermal changes	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
plastic shrinkage	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
drying shrinkage	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
structural overload	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
temperature/fire	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
radiation	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
other	_____			

Repair

Have you repaired damaged areas at the plant?      Yes       No

If yes:

What type of repair techniques have been used?

ROUTING

EPOXY INJECTION

Crack repairs

Epoxy injection	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
If yes, what material?	<u>SIKADUR 35 HI MOD LV</u>			
Routing and sealing	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
If yes, what material?	<u>SIKATOP 123</u>			
Stitching and additional reinforcement	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			
Drilling and plugging	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
If yes, what material?	<u>MASTERFLOW 928</u>			
Flexible sealing	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
If yes, what material?	<u>SIKAFLEX 1A</u>			
Grout injection	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			
Dry packing	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			

Polymer Impregnation Yes  No

If yes, what material? \_\_\_\_\_

Other \_\_\_\_\_

Spalling or Delamination Repairs

Concrete replacement Yes  No

If yes, what material? MASTERFLOW 928

Dry pack Yes  No

If yes, what material? \_\_\_\_\_

Pre-placed aggregate concrete Yes  No

Shotcrete Yes  No

If yes, what material? \_\_\_\_\_

Sealers Yes  No

If yes, what material? SIKAPRINTO 19

Other SIKATOP 123, SIKAPRINTO 32  
MASTERRATCH 20

Do you utilize cathodic protection of reinforced concrete? Yes  No

cathodic protection of prestressed concrete members? Yes  No

Damaged and/or Repaired Locations

Is your plant a boiling water reactor? Yes  No

Is your plant a pressurized water reactor? Yes  No   
(Go to section on pressurized water reactor)

Boiling Water Reactor

What areas of the plant have exhibited damage?  
Have these areas been repaired?

Concrete containment	<u>Damaged</u>		<u>Repaired</u>	
basemat foundation	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
drywell pedestal	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
vertical walls (Mark I)	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
steel liner	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
suppression chamber (Mark I)	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
chamber steel liner (Mark I)	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>

	<u>Damaged</u>	<u>Repaired</u>
vertical walls (Mark II)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
vertical walls (truncated cone - Mark II)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
concrete dome (Mark III)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
polar crane support (Mark III)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

#### Containment Internal structures

bottom slab (steel Mark I and pre-Mark containments)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
reactor pedestal/support structure	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
biological (Reactor) shield wall	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
floor slabs	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
walls	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
columns	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
diaphragm floor (Mark II)	N/A Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
NSSS equipment pedestals/supports	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
upper and fuel pool slabs (Mark III)	N/A Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
drywell wall (Mark III)	N/A Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
weir/vent wall (Mark III)	N/A Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
crane support structure (Mark III)	N/A Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

#### Secondary Containments/Reactor Buildings

basemat foundation (isolated from containment basemat)

walls	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
slabs	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
columns	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
equipment supports/pedestals	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/> SOME
sacrificial shield wall (Metal Containments)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
spent/New fuel pool walls/slabs	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
drywell foundation	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

#### Auxiliary Structures

foundations	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
walls	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

	<u>Damaged</u>		<u>Repaired</u>		
slabs	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
cable ducts	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
pipe tunnels	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
stacks	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
concrete intake piping	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
hyperbolic cooling towers	N/A	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
dams	N/A	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
intake crib structure	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
embankments	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
tanks	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
water wells	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
other					

#### PRESSURIZED WATER REACTOR

What areas of the plant have exhibited damage and have these areas been repaired?

concrete containment	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
basemat foundation	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
tendon access galleries	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
vertical walls (and buttresses)	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
ring girder	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
dome	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
liner	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>

#### Containment internal structures

bottom floor	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
floor slabs	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
walls	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
columns	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
NSSS equipment pedestals/supports	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
primary shield wall (reactor cavity)	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
reactor coolant vault walls	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>



	<u>Damaged</u>	<u>Repaired</u>
beams	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
crane support structures	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
ice condenser divider wall and slab	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
refueling pool and canal walls	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
<b>Auxiliary Structures</b>		
foundations	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
walls	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
slabs	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
cable ducts	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
pipe tunnels	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
stacks	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
concrete intake piping	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
hyperbolic cooling towers	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
dams	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
intake crib structure	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
embankments	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
tanks	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
water wells	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
other	_____	

General Comments

Do you have experience with durability of particular repairs Yes  No

Do you have experience with performance history of particular repairs Yes  No

Do you regularly evaluate repair performance Yes  No

If yes, how \_\_\_\_\_  
 \_\_\_\_\_

If yes has been answered to any of the above general comments, we would appreciate brief comments or copies of reports concerning these factors.

DETERIORATION AND REPAIR OF CONCRETE IN NUCLEAR POWER FACILITIES

A SURVEY OF PLANTS

Plant Manager T. G. BROUGHTON  
Plant Name TMI-1 NGS  
Address ROUTE 441 SOUTH  
MIDDLETOWN, PA. 17057

Type of Containment

Concrete Cylinder	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
Mark I	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
Mark II	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
Mark III	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
Other	<u>PWR by B&amp;W</u>			

Date of Commission 4-19-74  
Person Completing Survey KEN WHITMORE  
Telephone No. 201-316-7546  
Fax No. \_\_\_\_\_

Person(s) in Charge of Concrete  
Inspection and Repairs \_\_\_\_\_  
Telephone No. \_\_\_\_\_  
Fax No. \_\_\_\_\_

External Assistance

Do you use outside consultants for inspection of concrete structures?

Yes  No

If yes:

Consultant Name

MATCOR, INC (FOR COOLING TOWER VISUAL INSPECTION)

Contact Name

WILLIAM R. SCHUTT

Telephone No.

800-523-6692

Fax No.

215-348-2699

Do you use outside consultants for repair of concrete structures?

Yes  No

If yes:

Company Name

\_\_\_\_\_

Contact Name

\_\_\_\_\_

Telephone No.

\_\_\_\_\_

Fax No.

\_\_\_\_\_

General

Do you conduct regular inspections of the concrete in the plant?

Yes  No

FOR TENDON ANCHORAGE AREA

If yes:

How often do you conduct these surveys?

SEE NOTE AT BOTTOM OF THIS PAGE

If yes:

What techniques are used to inspect the concrete condition?

visual

Yes  No

1 OFTEN

half-cell potential tests for corrosion

Yes  No

SOMETIMES

removal of cores

Yes  No

SOMETIMES

HDT (pulse velocity, pulse echo, acoustic emission)

Yes  No

RARE

chemical analyses

Yes  No

VERY RARE

X-ray

Yes  No

RARE

other (describe)

\_\_\_\_\_

NOTE: THE ONLY FORMAL REGULAR INSPECTIONS OF CONCRETE PERFORMED AT TMI IS THE INSPECTION AROUND THE TENDONS CONDUCTED EVERY 5 YEARS. INFORMAL VISUAL INSPECTIONS ARE PERFORMED DURING EACH OUTAGE. IF DEGRADATION IS OBSERVED, MORE EXTENSIVE INVESTIGATIONS ARE PERFORMED AND TEMPORARY REGULAR INSPECTIONS ARE SCHEDULED TO DOCUMENT ANY ADDITIONAL DEGRADATION.

Observed Deterioration

Have you experienced damaged concrete in this plant? Yes  No

Have the following types of deterioration been located at the plant?

- |                                   |     |                                     |    |                                     |
|-----------------------------------|-----|-------------------------------------|----|-------------------------------------|
| voids/honeycomb                   | Yes | <input checked="" type="checkbox"/> | No | <input type="checkbox"/>            |
| cracking                          | Yes | <input checked="" type="checkbox"/> | No | <input type="checkbox"/>            |
| scaling                           | Yes | <input checked="" type="checkbox"/> | No | <input type="checkbox"/>            |
| spalling                          | Yes | <input checked="" type="checkbox"/> | No | <input type="checkbox"/>            |
| staining                          | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| corrosion of reinforcing steel    | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| degradation of prestressing steel | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| popouts                           | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| efflorescence                     | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| dusting                           | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| delamination                      | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |

other (please describe) STAINING OF Concrete due to Tendon grease leakage

Deterioration Mechanisms

Have you experienced concrete damage due to:

- |                                                |     |                                     |    |                                     |
|------------------------------------------------|-----|-------------------------------------|----|-------------------------------------|
| freeze/thaw                                    | Yes | <input checked="" type="checkbox"/> | No | <input type="checkbox"/>            |
| aggressive chemical attack                     | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| sulfate attack                                 | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| seawater exposure                              | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| acid attack                                    | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| abrasion                                       | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| impact                                         | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| corrosion of steel embedded in concrete        | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| carbonation                                    | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |
| corrosion of other metals embedded in concrete | Yes | <input type="checkbox"/>            | No | <input checked="" type="checkbox"/> |

If yes, describe \_\_\_\_\_

chemical reactions of aggregates	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
dimensional changes				
thermal changes	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
plastic shrinkage	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
drying shrinkage	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
structural overload	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
temperature/fires	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
radiation	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
other	_____			

Repair

Have you repaired damaged areas at the plant?      Yes       No

If yes:

What type of repair techniques have been used?

GROUT (PATCHING FOR SOME AREA, INJECTION FOR BLOCK WALLS)

\_\_\_\_\_

\_\_\_\_\_

Crack repairs

Epoxy Injection	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			
Routing and sealing	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
If yes, what material?	<u>SIKATCP 123</u>			
Stitching and additional reinforcement	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			
Drilling and plugging	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			
Flexible sealing	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
If yes, what material?	<u>SIKAFLEX 1a</u>			
Grout Injection	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			
Dry packing	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, what material?	_____			

Polymer impregnation Yes  No

If yes, what material? \_\_\_\_\_

Other \_\_\_\_\_

Spalling or Delamination Repairs

Concrete replacement Yes  No

If yes, what material? \_\_\_\_\_

Dry pack Yes  No

If yes, what material? \_\_\_\_\_

Pre-placed aggregate concrete Yes  No

Shotcrete Yes  No

If yes, what material? \_\_\_\_\_

Sealers Yes  No

If yes, what material? \_\_\_\_\_

Other \_\_\_\_\_

Do you utilize cathodic protection of reinforced concrete? Yes  No

cathodic protection of prestressed concrete members? Yes  No

Damaged and/or Repaired Locations

Is your plant a boiling water reactor? Yes  No

Is your plant a pressurized water reactor? Yes  No

(Go to section on pressurized water reactor)

Boiling Water Reactor (NA)

What areas of the plant have exhibited damage?  
Have these areas been repaired?

Concrete containment	<u>Damaged</u>		<u>Repaired</u>	
basemat foundation	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
drywell pedestal	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
vertical walls (Mark I)	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
steel liner	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
suppression chamber (Mark I)	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
chamber steel liner (Mark I)	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>

	<u>Damaged</u>	<u>Repaired</u>
vertical walls (Mark II)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
vertical walls (truncated cone - Mark II)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
concrete dome (Mark III)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
polar crane support (Mark III)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

Containment Internal structures

bottom slab (steel Mark I and pre-Mark containments)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
reactor pedestal/support structure	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
biological (Reactor) shield wall	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
floor slabs	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
walls	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
columns	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
diaphragm floor (Mark II)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
NSSS equipment pedestals/supports	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
upper and fuel pool slabs (Mark III)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
drywell wall (Mark III)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
weir/vent wall (Mark III)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
crane support structure (Mark III)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

Secondary Containments/Reactor Buildings

basemat foundation (isolated from containment basemat)

walls	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
slabs	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
columns	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
equipment supports/pedestals	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
sacrificial shield wall (Metal Containments)	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
spent/New fuel pool walls/slabs	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
drywell foundation	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

Auxiliary Structures

foundations	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
walls	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

	<u>Damaged</u>	<u>Repaired</u>
slabs	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
cable ducts	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
pipe tunnels	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
stacks	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
concrete intake piping	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
hyperbolic cooling towers	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
dams	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
intake crib structure	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
embankments	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
tanks	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
water wells	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
other		

#### PRESSURIZED WATER REACTOR

What areas of the plant have exhibited damage and have these areas been repaired?

concrete containment	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
basemat foundation	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
tendon access galleries	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
vertical walls (and buttresses)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
ring girder	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
dome	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
liner	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

#### Containment internal structures

bottom floor	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
floor slabs	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
walls	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
columns	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
NSSS equipment pedestals/supports	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
primary shield wall (reactor cavity)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
reactor coolant vault walls	Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

N/A



	<u>Damaged</u>	<u>Repaired</u>
beams	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
crane support structures	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
ice condenser divider wall and slab <i>NA</i>	<del>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></del>	<del>Yes <input type="checkbox"/> No <input type="checkbox"/></del>
refueling pool and canal walls	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>

**Auxiliary Structures**

foundations	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
walls	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
slabs	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
cable ducts	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
pipe tunnels	Yes <input checked="" type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
stacks	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
concrete intake piping	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
hyperbolic cooling towers	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
dams	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
intake crib structure	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
embankments	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
tanks	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
water wells	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>
other		

General Comments

Do you have experience with durability of particular repairs Yes  No

Do you have experience with performance history of particular repairs Yes  No

Do you regularly evaluate repair performance Yes  No

If yes, how VISUAL INSPECTION

If yes has been answered to any of the above general comments, we would appreciate brief comments or copies of reports concerning these factors.