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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

GPU NUCLEAR CORPORATION

THREE MILE ISLAND, UNIT NO. 1

DOCKET NO. 50-289

RESTART TEST PROGRAM

BACKGROUND AND DISCUSSION:

Three Mile Island Nuclear Station Unit No. 1 (TMI-1 or Unit 1) began commercial operation on September 2, 1974. In March 1979, after 4 1/2 years of operation, the fourth refueling was completed. On March 28, 1979, before Unit 1 started up for its fifth cycle of operation, the accident occurred at Unit 2. Although no damage was incurred on Unit 1, it remained shut down pending investigation of the Unit 2 event. On July 2, 1979 the Nuclear Regulatory Commission (NRC) ordered Unit 1 to remain in a cold shutdown condition until further order of the Commission. The Commission's order of August 9, 1979 specified the basis for its concern regarding restart of Unit 1, and identified certain short term and long term actions that the Director of Nuclear Reactor Regulation had recommended be required of the licensee. The same Order directed that a public hearing be held and the Atomic Safety and Licensing Board, among other things, was directed to determine whether the short term actions identified in the August 9, 1979 Order were necessary and sufficient to permit the safe operation of TMI-1 in the short

term and whether the long term actions were necessary and sufficient to permit safe long term operation of TMI-1.

In June 1980, the Office of Nuclear Reactor Regulation (ONRR) issued NUREG-0680, "Evaluation of Licensee's Compliance with the Short and Long Term Items of Section II of the NRC Order dated August 9, 1979". As additional items were resolved, ONRR issued NUREG-0680 Supplement No. 1 (November 1980), Supplement No. 2 (March 1981), and Supplement No. 3 (April 1981). It was concluded, in part, in Supplement No. 3, that the licensee was in compliance with the requirements of the August 9, 1979 Commission Order with regard to the short-term actions identified in NUREG-0680 and its supplements, subject to verification of installation of modifications and completion of all required tests and exercises discussed in NUREG-0680, including Supplement No. 3.

By letter dated January 28, 1981, ONRR requested that Metropolitan Edison Co. propose a special low power test program similar to those performed by near term operating license applicants in response to NRC Task Action Plan Item I.G.1. This test provides additional operator training when operating the plant in a natural circulation cooling mode. On April 22, 1981, representatives of the NRC and the licensee met to discuss all of the plant tests that would be performed prior to restart, during low power testing, and during power escalation. On May 6, 1981 the licensee submitted its Restart Test Planning Specification including the special low power tests discussed in Task Action Plan Item I.G.1. Representatives of NRC and the licensee met again on July 23, 1981 to discuss NRC staff comments on the pro-

posed Restart Test Planning Specification. On September 22, 1981 the licensee submitted written responses to the NRC comments on the test specifications.

EVALUATION

The purpose of this review was to determine whether an adequate test program had been established for the restart of Unit 1. The objectives of the test program are to: (1) demonstrate that structures, systems and components important to safety will function satisfactorily while in service, (2) verify that modifications performed during the shutdown were satisfactorily completed and accomplish the intended objective, (3) validate certain plant emergency operating procedures, and (4) perform a special low power test program that will provide supplemental operator training for the control of the saturation margin, the heat removal rate, and the pressurizer level while cooling by means of natural circulation.

In determining which systems should be tested prior to restart, we considered the importance of each system with regard to safe facility operation, whether the system had been modified while shutdown, and the maintenance and surveillance testing performed during the extended shutdown period. The systems important to safety include those that:

1) Will be used for shutdown and cooldown of the reactor under normal plant conditions and for maintaining the reactor in a safe condition for an extended shutdown period.
2) Will be used for shutdown and cooldown of the reactor under transient (infrequent or moderately frequent events) condi-

tions and postulated accident conditions, and for maintaining the reactor in safe condition for an extended shutdown period following such conditions.

3) Will be used for establishing conformance with safety limits or limiting conditions for operation as given in the facility technical specifications.

4) Are classified as engineered safety features or will be relied on to support or ensure the operations of engineered safety features within design limits.

5) Are assumed to function or for which credit is taken in the accident analysis of the facility, as described in the FSAR, and

6) Will be used to process, store, control, or limit the release of radioactive materials.

We have reviewed the licensee's letter of May 6, 1981 including the Restart Test Planning Specification and the abstracts of tests related to cooling by natural circulation. The licensee stated that there are three major aspects to the overall restart program: (1) the ongoing preventive maintenance program, (2) the Technical Specification surveillance program, and (3) the Restart Test Planning Specification. The preventive maintenance program implemented during the extended shutdown placed heavy emphasis on the maintenance of all plant equipment in a proper layup condition so it would be ready for return to operating service. Reactor Coolant Pumps were periodically operated, Control Rods were exercised, and the secondary systems were operated for equipment check-out and operator training. Primary and secondary water chemistry procedures and limits for long term shutdown

condition were used to minimize chemistry related degradation of systems and components.

The periodic surveillances required by the Technical Specifications were performed throughout the shutdown period. Systems and components required to be operable in the shutdown mode were operated and tested in accordance with the requirements of the Technical Specifications to assure continued operability and readiness of emergency equipment.

The licensee's Restart Test Planning Specification lists the tests that will be performed prior to and during the restart of Unit 1. These tests will supplement the testing required by the Unit 1 Technical Specifications and by the Preventive Maintenance Program. These tests will be performed to verify the operability of systems that have been modified in accordance with the NRC order and the "Lessons Learned" from TMI Unit 2.

We have compared the licensee's test specification with the NRC order items and "Lessons Learned" items as presented in NUREG-0680. Enclosure 1 (table 640.9) is a list of the items given in NUREG-0680 with a corresponding test number listed in the test specification. NRC comments resulting from our initial review of the test specification are also provided in the table. Our comments generally requested greater specificity in the test acceptance criteria, suggested additional testing not included in the test specification, and called for the validation of operating procedures and operator training

during certain test operations. We also reviewed the method by which all plant modifications were accounted for, and how the Test Working Group and the Plant Operations Review Committee functioned to assure that adequate precautions and prerequisites were included in the test procedures. The staff also requested clarification of the tests of radiation monitors, and the number and arrangement of operable core exit thermocouples required for the detection of inadequate core cooling. The licensee provided satisfactory responses to our comments by letters dated September 22, 1981 and February 2, 1982.

Unit 1 restart testing will include a special low power test program similiar to the test programs being performed during the initial startup of new plants. These special tests will demonstrate plant operating characteristics when being cooled by natural circulation. Characteristics such as the length of time required to establish natural circulation and the ability to cool down by natural circulation will be verified. A major purpose of these tests is to provide operator training in the initiation, maintenance, and recovery from the natural circulation mode of operation. Operators will acquire a better understanding of when natural circulation has been established and will experience control of the reactor coolant saturation margin, pressure, and heat removal rates. Enclosure 2 is a description of the tests that will be performed. We have reviewed abstracts of these tests. The testing includes

the use of operating procedures for natural circulation cooling. These procedures may be revised as the result of the experience gained during this testing. We have concluded that the objectives of the NRC's TMI Action Plan Item I.G.1 will be met by the special test and that adequate operator training, natural circulation testing, and procedures validation will be provided.

To demonstrate the safety of operations during low power natural circulation testing, the licensee provided a safety analysis. The analysis considered the temporary exceptions to the technical specifications that will be necessary to allow the performance of the tests. The analysis also considered the occurrence of accidents previously analyzed in the Final Safety Analysis Report. The licensee submitted this analysis as part of Technical Specification Change Request No. 108 dated November 10, 1981. The staff has completed its review of this analysis to support TSCR No. 108 and will be issuing an amendment to the Technical Specifications for Unit 1 in the near future.

It should be noted that during plant testing in November 1981, primary to secondary leakage was discovered. Subsequently, after extensive analysis, it was determined that intergranular stress corrosion cracking (IGSCC) existed in thousands of the steam generator tubes. The licensee is in the process of repairing the defective steam generator and the licensee's entire steam generator program is being monitored closely by the NRC. As part of the steam generator program, the

licensee will conduct extensive testing of the plant and steam generators to verify that the repaired steam generators function as designed and that the IGSCC will not reinitiate. The testing program as well as other aspects of the steam generator corrosion will be reviewed by the staff and the review will be documented in a safet evaluation prior to authorization to restart TMI-1. Hence, this evaluation of the licensee's restart testing program does not address the steam generator program.

CONCLUSION:

Based on our review, we have concluded that the TMI-1 Restart Test Program complies with testing requirements of NUREG-0680, including Supplements 1, 2 and 3 thereto; and that successful completion of the restart test program will demonstrate the functional adequacy of plant structures, systems, and components for the safe startup and operation of Unit No. 1. We have also determined that the licensee's low power natural circulation test program will provide significant additional operator training, will verify natural circulation characteristics, and will validate the operating procedures for natural circulation conditions.

ENCLOSURE 1

TABLE 640.9
COMPARISON OF NRC ORDER ITEMS AND GPU TEST SPECIFICATION

STATUS SUMMARY - SHORT-TERM ITEMS

Order Item	Item Description	NUREG 680 PAGE	GPU Test #/PAGE	Comment
Short Term				
1a-1	Auto initiation of AFW	C1-1	13 a,e/8	OK
-2	AFW valves fail open	C1-2	13 c,h/10	OK
-3	Auto AFW load on diesels	C1-3	13 a,e/8	Include pressurizer heater load
-4	AFW tech specs	C1-4		Verify 500 gpm and flow path
-5	AFW flow indication	C1-5	13 b/9	OK
-6	AFW procedures	C1-6		Validate procedures and provide training
-7	AFW alignment	C1-7		Validate procedures and provide training
-8	AFW auto start annunciate	C1-7		Specify start signals
1a-Add'l	Reliability Analysis			
1	Redundant instrumentation	C1-8	13 i/11	Specify setpoints for 20 min. supply
2	Endurance Test	C1-8	13/12	Specify or reference design limits
3	Transfer of EFW Supply	C1-8		Validate procedures and providing training
4	EFW to intact OTSG	C1-9		Verify auto termination of EFW Flow
5	Auto EFW protection on loss of water source	C1-9		No action required
6	EFW initiation independent of AC	C1-9	13 h/10	OK
7	EFW operability in steam environment	C1-10		Test EFS valve operation with new parts
8	Cross-tie break			No action required
1b	EFW independent of ICS	C1-11	13 d/9	14 (4)/29 Validate procedures and provide trainin
1c	Reactor trip on feed trip	C1-12	3/2	OK
1d	Small breaks analysis	C1-13	9/6	Verify new setpoints: Lo & Hi Pressure R.trip and ESFAS
1e	Operator retraining	C1-16		List tests that provide specific training

Order Item	Item Description	NUREG 680	GPU Test	Comment
2	IE Bulletins			
79-05A-1	Accident understanding	C2-2		Complete
-2	Plant transient review	C2-3		Verify integrity of PORV discharge piping
-3	Transient procedures	C2-4		Complete
-4	Operating procedures	C2-4	14/12	Validate procedures and provide training
-5	Valve position review	C2-6		(By IE)
-6	Containment isolation	C2-6	5/4	See 2.1.4 and NUREG 680 Supp. 3
-7	EFW valve procedures	C2-6		Include in 79-05A-5
-8	EFW operability	C2-6		OK
-9	Transfer of containment liquids	C2-7	5/4	Test isolation and define reset modes
-10	Safety system operability	C2-7		Validate procedures
-11	Personnel actions - TMI-2	C2-8		Complete
-12	Prompt reporting	C2-8		Complete - see 79-05B-6
79-05B-1	Natural circulation			Provide analyses
-2	Vessel integrity	C2-10		Complete
-3	PORV setpoint	C2-11		Verify: Rxtrip 2300 psig PORV 2450
-4	Manual reactor trip	C2-12		Complete
-5	Anticipatory trips	C2-14	13 a,e/8	Perform RPS check-out
-6	Prompt reporting	C2-14		Complete
-7	Tech Spec changes	C2-14		Under review
79-05C-1	RCP trips	C2-16		Complete
-2	Small LOCA analysis	C2-16		Complete
-3	Operator action-RCP trips	C2-16		Complete
-4	Reactor trip training	C2-17		Complete
-5	Inadequate core cooling	C2-18		Complete
79-05C				
Long term 1	Auto RCP trip	C2-18		Not prior to restart
3	Emergency Preparedness	C3-1		Tested 6/2/81
3a	Emergency plan update	C3-1		Tested 6/2/81
3b	Emergency operations center	C3-1		Tested 6/2/81
3c	Offsite monitoring	C3-1		Test instrumentation
3d	State/local plans	C3-1		Tested 6/2/81
3e	Test exercise	C3-1		Tested 6/2/81

Order Item	Item Description	NUREG 680	GPU Test	Comment
4	Separation of TMI-1 & 2	C4-1		
	Liquid radwaste			Test
	Gaseous radwaste	C4-8		Test dampers and demonstrate air flow
	Solid radwaste			Test
	Monitoring system			Test instrumentation
	Sampling systems			
5	Waste management	C5-1		Test Radiation Monitoring systems
	Liquid & gaseous systems			
	Solid radwaste system			
6	Managerial Capability			
	Management & technical			
	Safety review			
	Plant maintenance			
	Operations training			
	Operational QA			
	Facility procedures			
	Health physics			
7	Financial Qualifications (1)			
8	Lessons Learned - Short term			
2.1.1	Emergency Power Supply			
	Pressurizer heaters	C8-8	16/13	OK
	Pressurizer levels & block valves	C8-10		No mod. required: See NUREG 680 Supp. 3 Page 24
2.1.2	Relief valve testing	C8-10		EPRI Testing - OK
2.1.3.a	Valve position indication	C8-11	10/6	OK
2.1.3.b	Inadequate core cooling	C8-14	4/3	
	Existing instrumentation			Test 50 thermocouples, computer read out and extended range of T_H
	Saturation meter	C8-16	LM-1/15	Provide quantitative acceptance criteria
	New instrumentation	C8-19		Provide schedule

(1) Compliance with Order Item 7 is no longer a hearing item per Commission Order (CLI-81-3)

Order Item	Item Description	NUREG 680	GPU Test	Comment
2.1.4	Containment isolation	C8-21	5/4	Test mods described in NUREG 680 Supp 3 page 32
2.1.5.a	Dedicated recombiner penetrations	C8-26	12/7	Provide quantitative acceptance criteria
2.1.5.b	Inerting BWR containments			Not applicable
2.1.5.c	Install recombiners	C8-29	12/7	Specify or refer to Quantitative Acceptance Criteria/Test piping and power supplies
2.1.6.a	System integrity	C8-31	30/34	What systems.- NUREG 680 Supp 3 page 35
2.1.6.b	Plant shielding	C8-32		Not prior to 1/1/82.
2.1.7.a	AFW auto initiation	C8-34	13/8	See Order item 1a-1-3 & 4 above
2.1.7.b	AFW flow indication	C8-38	13b/9	OK
2.1.8.a	Post-accident sampling	C8-41	34/20	Drill - OK
2.1.8.b	Radiation monitor range	C8-42	29/21	See 680 Supp. 3 page 42 for acceptance critiera 1/1/82
2.1.8.c	Iodine instrumentation	C8-46		Test monitors
2.1.9	Accident Analysis			OK
2.2.1.a	Shift supervisor responsibilities	C8-47		Provide training during test LM-1/15
2.2.1.b	Shift Technical Advisor			
2.2.1.c	Shift Turnover	C8-54		IE check effectiveness of procedures
2.2.2.a	Control room access	C8-55		IE observe access
2.2.2.b	Onsite Tech Support Center	C8-56		Test communications & rad. monitors (IE)
2.2.2.c	Onsite Operations Support Center	C8-59		Test communications & rad. monitors (IE)
3				
Add 4	RCS Venting	C8-60		Test RCS Vent system pressurizer only
Add 1	Containment Pressure	D3-1		Test 1/1/82
Add 2	Containment Water Level	D3-2		Test added sump & bldg. level 1/1/82
Add 3	Containment Hydrogen	D3-2		Test 1/1/82

LOW NUCLEAR POWER TESTING
INCLUDING NATURAL CIRCULATION

1) Perform correlation between Out of Core Detector indication vs. Heat Balance Power as a function of T_{COLD} (3% Power)

2) Verify auto start of Emergency Feedwater Pumps and OTSG Level Control at 30" on Startup Range upon loss of both Feedwater Pumps and demonstrate adequacy of flow indication (RM-13B) (3% Power)

3) Verify ability to control level with the new Manual Loader Station (RM-13D) (3% Power)

4) Verify adequate air supply to Emergency Feedwater Control Valves (EF-V30A/B) and Turbine Driven Emergency Feed Pump Steam Control Valve (MS-V6) for 2 hours with loss of Instrument and Backup Instrument Air (RM-13H) (3% Power)

5) Verify smooth transition to Natural Circulation Flow with OTSG Level Conrol at 50% on Operating Range upon loss of all 4 RCP's and demonstrate adequacy of flow indication (RM-13B) (3% Power)

6) Determine effect of loss of Pressurizer Heaters on Saturation Margin (3% Power)

7) Determine effect of SG Level on Natural Circulation Flow (3% Power)

8) Verify that OP 1102-16 (RCS Natural Circulation Cooling) provides adequate guidance to prevent overcooling as OTSG Level Control setpoint changes from 30" on Startup Range to 50% on Operating Range (Following 40% Power Trip)

LOW NUCLEAR POWER TESTING INCLUDING
NATURAL CIRCULATION (CONTINUED)

9) DETERMINE LOWEST LEVEL IN OTSG THAT SUSTAINS NATURAL CIRCULATION FLOW WITH NO EMERGENCY FEEDWATER (FOLLOWING 100% POWER TRIP)