FEB 18 1982

MEMORANDUM FOR: H. R. Denton, Director, NRR

FROM: R. J. Mattson, Director, DSI

SUBJECT: TRANSMITTAL OF REPORT ON REDUCTION IN RISK ASSOCIATED WITH THE PROPOSED LOW POWER TESTING PROGRAM AT LASALLE.

At your request we have prepared the enclosed report on low power risk reduction at LaSalle. The principal contributors were Norm Lauben, Tim Collins, Chuck Graves, Wayne Hodges, from RSB and Pat O'Reilly and Ashok Thadani from RRAB. The report concludes that the risk reduction for low power of this BWR is similar to the risk reduction previously estimated for various PWRs.

Original Signed by:
Roger J. Mattson

Roger J. Mattson, Director
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LF/ADOCKET 50-373

ENCLOSURE

REDUCTION IN RISK ASSOCIATED WITH THE PROPOSED
LOW POWER TESTING PROGRAM AT LA SALLE

SUMMARY:

The applicant, Commonwealth Edison, has requested a license to operate the La Salle County Station Unit 1 up to 5% of rated power during its low power testing program. The applicant has stated that the planned period of time at or near 5% power would be about 14 days. We have examined the reduction in risk associated with this proposed testing program compared to long-term full power operation. The assessment was similar to that conducted for several PWR's during the past 2 years. There are three major factors which contribute to a substantial reduction in risk for low power testing as compared to equilibrium full power operation. First, there is additional time available for the operators to correct the loss of important safety systems needed to mitigate relatively high risk events, or to take alternate courses of action. Second, the fission product inventory during this time would be very much less than during full power operation. Third, there is a reduction in required capacity for mitigating systems at low power. From an examination of these factors we believe that the reduction in instantaneous risk to the public is on the order of 2,000 to 200,000 if La Salle is operated at 5% power from initial startup for 14 days compared to equilibrium full power operation.

DISCUSSION:

Since the publication of the Reactor Safety Study (WASH-1400), the NRC staff and the industry have continued to study the risk to the public from potential severe accidents at nuclear power plants. This effort has confirmed that the event scenarios dominating accident risks are generally the same for different classes of BWRs. Although a risk assessment study has not been performed for a BWR-5 (the

La Salle class of plants), studies do exist for a BWR-4 (Limerick) and a BWR-6 (Grand Gulf). The appropriate similarities and differences were considered in evaluating the relative low power risk for La Salle.

It was determined for this assessment that the events which dominate risk for a BWR could be placed in four categories:

1. Events (both LOCA and non-LOCA) which include reactor scram but failure to remove heat from the containment.
2. Non-LOCA events which include reactor scram but failure to inject water into the reactor vessel.
3. LOCA's with failure of the required ECCS.
4. ATWS events.

The events in these 4 categories were examined to estimate the reduction in the probability of the event because of the additional time available during low power operation for the reactor operators to correct the loss of important safety systems or to take alternate courses of action. Similarly, we have calculated the reduced fission product inventory for operation of an initially unirradiated core at 5% power for 14 days and have determined the reduction in potential public exposure via reduction in potential release magnitudes. Risk is roughly proportional to the probability of severe accidents (in which the heat sink is lost) and to the fission product inventory in the core. From these factors we believe that the overall reduction in instantaneous risk to the public is on the order of 2,000 - 200,000 if LaSalle is operated at 5% power from initial startup for 14 days compared to continuous full power operation.

It is very important to recognize that this report is based on some very rough estimates. A detailed review of each event tree was not possible in the time alloted. Also computer analyses of the important events (ATWS and LOCA) were not possible. Therefore only estimates and inferences from previous work were used. For these reasons the risk reduction numbers have larger uncertainites than they otherwise might.

Category 1 Events

Following operation at full power, category 1 events will result in suppression pool heatup and boiling. Suppression pool boiling can overpressurize the containment or result in a reduction in pool level such that net positive suction head (NPSH) to the ECCS pumps is lost. Either containment overpressurization or loss of NPSH defeats the role of the suppression pool as the medium for post accident heat removal.

Following operation at 5% power for two weeks, failure to remove heat from the suppression pool results in a very slow increase in pool temperature due to decay heat. The capacity of the suppression pool is very large ($\sim$1 million gallons) and is considered to have an allowable temperature rise of about 110°F. For those events resulting in transfer of primary system stored energy to the pool, the initial increase in pool temperature is about 50°F. The decay heat load for the next three days would increase the pool temperature by about another 20°F. A 70°F increase in pool temperature poses no threat to containment or the ECCS pump NPSH requirements. Because of the time available, there is a high probability that the operator can take corrective actions to restore pool cooling. For this reason and the low fission product inventory, we believe that the risk due to events in category 1 is reduced by at least a factor of 40,000.

Category 2 Events

Following full power operation, category two events would result in reactor coolant boiloff, fuel heatup, and finally fuel melting. Following 5% power operation for two weeks, the decay heat rate is so low that, even if passive systems heat losses are neglected, several days would be needed to reduce vessel water level to the top of the active fuel region. At this time, decay heat rate is far below normal passive heat losses to the drywell. Hence, drywell cooler operation could stop boiloff. Because of time available, there is a high probability that the operator can take action to correct ECCS malfunctions or use other systems to restore vessel inventory. For these reasons, we believe that the risk due to category 2 events that result in excessive fuel damage and significant radiological release is reduced by at least a factor of 40,000.

Category 3 Events

The most significant events in this category are the transient induced LOCAs in which a safety relief valve sticks open. Because of the reduced system pressure and temperature in this class of events, passive system heat losses are substantially less than categories 1 and 2. Therefore boiloff could continue to eventual core melt at 5% power if some minimal core cooling is not established. For these events, several hours would elapse before core uncovery would begin and several more hours before uncovery of higher powered center core regions would uncover and core damage would occur. Because of the time available, the operator has a high probability of correcting ECCS malfunctions or cooling with alternate systems. For LaSalle only one control rod drive pump would be more than sufficient to remove decay heat. The RCIC system would be available for a while. BWR emergency procedures instruct the operator to use other backup systems as well. For these reasons we believe that the risk due to events in category 3 resulting in excessive fuel damage and significant radiological release is reduced by factors on the order of 1000 to 100,000.

Category 4 Events

For ATWS events, the low initial power results in a slower rate of heatup of the suppression pool and a large decrease in the amount of sodium pentaborate required to take the reactor to a subcritical condition relative to the full power case. It is estimated that about 2 hours operation at 5 percent power would be required to raise the suppression pool bulk temperature to 200°F assuming operation of both RHR heat exchangers. However, less than about 15 minutes operation of the Standby Liquid Control System (SBLCS) would be needed to reach a subcritical, hot standby condition. Because of the additional time available to the operators to act to mitigate ATWS events, and the lower fission product inventory resulting from low power operation, we believe that the risk reduction from category four events is on the order of 1,000 - 100,000.

CONCLUSIONS:

The above discussion indicates a significant risk reduction during low power testing for each event category. Combining the factors for each category, we estimate that the overall reduction in instantaneous risk to the public should be on the order of 2,000 to 200,000, if La Salle is operated at 5% power from initial startup for 14 days compared to equilibrium full power operation. This reduction is similar to that previously estimated for several PWRs.

ATTACHMENT 2

Inspection Plan for Division I

Diesel Generator

TABLE 1

PROPOSED CGNS INSPECTION PLAN, DIV 1 D/G (See Note 1)

TDI Comp. #	Part Name	Drawing Part Number	Drawing Number	Item #	Task Descriptions	Inspection Type: Visual	Dmsn	NDE	Hdns	Torque Comp.	Notes
02-360A	Cylinder Heads	03-360-03-0F	03-360-04		Inspect Valve Seating Surfaces and Fire Deck	X		UT* LP** MT***			* Fire Deck & Nozzel Cavity Wall Thickness ** Valve Seats & *** Fire Deck Area
02-305A	Engine Base Assembly	02-305-05-AA			LP Main Bearing Saddle Area and Visually Inspect Mating Surfaces	X		LP			Assemble Documentation, See Note 1
02-390G	Rocker Arm Capscrews	02-390-01-0B	02-390-04	3	Verify Torque M.T. Capscrews & Verify Material			M.T.	X	365 ft-lbs X	
02-315A	Cylinder Block	02-315-03-AE	02-315-5001	1	Visual NDE Map for Baseline	X		LP*			* Cylinder Block Mating Surface Bolt Hole Area, See note 1
02-315E	Cylinder Head Studs	03-315-01-0A	02-315-5001	8	Visually Inspect Head Studs, Material Hardness & Torque Verification on Studs	X			X*	3600 ft/lbs X**	* One Stud ** Four Studs
02-315C	Cylinder Liners	02-315-02-0G	02-315-5001	4	Visually Inspect Dimensional Material Verification	X*	X*		X*	X*	* Cylinder Liners, See note 1
	Landing Area					X**	X**	LP**			** Landing Area

TABLE 1

PROPOSED CGNS INSPECTION PLAN, DIV 1 D/G (See Note 1)

TDI Comp. #	Part Name	Part Number	Drawing Number	Item #	Task Descriptions	Inspection Type: Visual	Dmsn	NDE	Hdns	Torque	Comp.	Notes
02-475C	Turbocharger Welds		02-475-22		Visual	X						Assemble Documentation
	Bracket-Bolting See note 1	GB-001-143 GB-001-117	02-475-22	3 13	Verify Torque Material	X				X	X	Assemble Documentation, See note 1
02-340A	Connecting Rod Boxes	02-340-05-AG	02-340-4780	19	Rod Box (out-of-engine)	X	X	MT	X		X	▲ Female Threads in Rod Box & External Machined Surface, See note 1
		02-340-04-AB		5	Rod Box Bolts (out-of-engine)			MT**		2600*** ft/lbs		** Conn Rod Bolts *** At Disassembly & Reassembly
02-340A	Connecting Rod Bushing (Wrist Pin)	R-3195	02-340-4780	10	NDE & Material Verification		X	LP			X	
02-340B	Connecting Rod Bearing Shells	02-340-04-AG	02-340-05	3	RT Shells, Visual Inspection, & Dimensional Check	X	X	RT		2600* ft/lbs		RT to ASTM Standards * At Disassembly & Reassembly
02-340C	Pistons Crowns Studs	03-341-04-AE 03-340-04-AE 03-341-04-AB	03-341-7319	10	MT Skirts, Crowns & Studs		X	MT				
02-310A	Crankshaft	1A-5445	02-310-09	1	Torsiograph Deflection Test		X					Torsiograph
02-386B	Crankcase Covers: Gaskets & Bolting		02-386-01		Visual Inspect Verify Torque	X				X		

TABLE 1

PROPOSED GGNS INSPECTION PLAN, DIV I D/G (See note 1)

TDI Comp. #	Part Name	Part Number	Drawing Number	Item #	Task Description	Inspection Type					Notes
						Visual	Dmsn	NDE	Hdns	Torque Comp.	
02-365C	Fuel Oil Injection Tube	1A-2600	02-365-01	4	Visual Inspection for Leaks	X					Assemble Documentation
02-390C	Intake Exhaust Push Rods	02-390-06-AB	02-390-04	4	Visual	X					Friction Weld Assemble Documentation
02-390D	Connector Push Rods	02-390-07-AG	02-390-04	5	Visual	X					Friction Weld Assemble Documentation
02-359	Air Start Valve Capscrews	GB-032-114	02-359-03	19	Visual		X				Assemble Documentation, See note 1

Note: 1. The NRC requires additional inspections for these components as identified in Table 2.

TABLE 2

Additional Inspections Required by NRC

	Additional Inspection Required
Engine Base Assembly	Fastener torques should also be checked.
Cylinder Block	Visual and LP Inspection should also include liner lands of engine block.
Cylinder Liners	LP inspection should also be performed. In addition, lightly hone any glazed areas of liners in accordance with the manufacturers recommendations.
Turbocharger Thrust Bearings	Inspect for wear, check motor assembly axial clearances, check bearing oil flow rates per criteria employed by TDI Owners Group.
Air Start Valve Capscrews	Torques should also be checked.

ATTACHMENT 3 TO ORDER REQUIRING DIESEL GENERATOR INSPECTION
FACILITY OPERATING LICENSE NO. NPF-13
Docket No. 50-416

Replace the following pages of the appendix A Technical Specifications with the enclosed pages. The revised pages are identified by date of Order and contain a vertical line indicating the area of change. The corresponding reverse pages are also provided to maintain document completeness.

Amended Page	Reverse Page
3/4 8-1	
3/4 8-2	
3/4 8-2a	
3/4 8-3	
3/4 8-4	
3/4 8-5	
3/4 8-6	
3/4 8-7	
3/4 8-7a (new page)	3/4 8-8
3/4 8-9	
3/4 8-9a	
B3/4 8-1	B3/4 8-2

3/4.8 ELECTRICAL POWER SYSTEMS

3/4.8.1 A.C. SOURCES

A.C. SOURCES - OPERATING

LIMITING CONDITION FOR OPERATION

3.8.1.1 As a minimum, the following A.C. electrical power sources shall be OPERABLE:

a. Three physically independent circuits between the offsite transmission network and the onsite Class 1E distribution system, and

b. Two separate and independent diesel generators, each with:

1. Separate day fuel tanks containing a minimum of 220 gallons of fuel.

2. A separate fuel storage system containing a minimum of:

a) 48,000 gallons of fuel for diesel generator 12, and

b) 39,000 gallons of fuel for diesel generator 13.

3. A separate fuel transfer pump.

c. The 6200 kW gas turbine generator system consisting of 3 gas turbines, with:

1. A separate day fuel tank containing a minimum of 300 gallons of fuel for each gas turbine, and

2. A fuel storage system consisting of:

a) A makeup fuel tank containing a minimum of 300 gallons of fuel, and

b) A fuel storage tank containing a minimum of 52,000 gallons of fuel, and

c) A fuel transfer pump.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, and 3.

ACTION:

a. With one offsite circuit of the above required A.C. electrical power sources inoperable, demonstrate the OPERABILITY of the remaining A.C. sources by performing Surveillance Requirements 4.8.1.1.1.a within two hours and 4.8.1.1.2.a.4, for one diesel generator at a time, within two hours and at least once per 8 hours thereafter, and 4.8.1.1.4.b.1 within two hours and at least once per 8 hours thereafter; restore all three offsite circuits to OPERABLE status within 72 hours or be in at least HOT SHUTDOWN within the next 12 hours and in COLD SHUTDOWN within the following 24 hours.

ACTION (Continued)

2. Diesel generator 12 shall be started, brought to operating voltage and speed, and maintained running until the adverse weather condition warning has cleared.

3. All three gas turbine generators shall be started, brought to rated voltage and speed, and maintained running until the adverse weather condition warning has cleared.

g. With a tornado or hurricane watch in effect:

1. Diesel generator 13 shall be demonstrated to be OPERABLE per Specification 4.8.1.1.2.a.4 within two hours and at least once per eight hours thereafter until the adverse weather condition watch has cleared.

2. Diesel generator 12 shall be demonstrated to be OPERABLE per Specification 4.8.1.1.2.a.4 within two hours and at least once per eight hours thereafter until the adverse weather condition watch has cleared.

3. All three gas turbine generators shall be demonstrated to be OPERABLE per Specification 4.8.1.1.4.b.1 within two hours and at least once per 8 hours thereafter until the adverse weather condition watch has cleared.

c. At least once per 92 days and from new oil prior to addition to the storage tanks by verifying that a sample obtained in accordance with ASTM-D270-1975 has a water and sediment content of less than or equal to .05 volume percent and a kinematic viscosity @ 40°C of greater than or equal to 1.9 but less than or equal to 4.1 when tested in accordance with ASTM-D975-77, and an impurity level of less than 2 mg. of insolubles per 100 ml. when tested in accordance with ASTM-D2274-70, except that the test of new fuel for impurity level shall be performed within 7 days after addition of the new fuel to the storage tank.

d. At least once per 18 months, during shutdown, by:

1. Subjecting the diesel to an inspection in accordance with procedures prepared in conjunction with its manufacturer's recommendations for this class of standby service.

2. Verifying the diesel generator capability to reject a load of greater than or equal to 550 kW (RHR B/C Pump) for diesel generator 12, and greater than or equal to 2180 kW (HPCS Pump) for diesel generator 13 while maintaining less than or equal to 75% of the difference between nominal speed and the overspeed trip setpoint, or 15% above nominal, whichever is less.

3. Verifying the diesel generator capability to reject a load of 7000 kW for diesel generator 12 and 3300 kW for diesel generator 13 without tripping. The generator voltage shall not exceed 5000 volts during and following the load rejection.

4. Simulating a loss of offsite power by itself, and:

a) For Division 2:

1) Verifying deenergization of the emergency busses and load shedding from the emergency busses.

2) Verifying the diesel generator starts on the auto-start signal, energizes the emergency busses with permanently connected loads within 10 seconds, energizes the auto-connected shutdown loads through the load sequencer and operates for greater than or equal to 5 minutes while its generator is loaded with the shutdown loads. After energization, the steady state voltage and frequency of the emergency busses shall be maintained at 4160 ± 416 volts and 60 ± 1.2 Hz during this test.

b) For Division 3:

1) Verifying de-energization of the emergency bus.

2) Verifying the diesel generator starts on the auto-start signal, energizes the emergency bus with the loads within 10 seconds and operates for greater than or equal to 5 minutes while its generator is loaded with the shutdown loads. After energization, the steady state voltage and frequency of the emergency bus shall be maintained at 4160 ± 416 volts and 60 ± 1.2 Hz during this test.

SURVEILLANCE REQUIREMENTS (Continued)

8. Verifying that all automatic diesel generator trips are automatically bypassed upon an ECCS actuation signal except:

   a) For Division 2, engine overspeed, generator differential current, low lube oil pressure, and generator ground overcurrent.

   b) For Division 3, engine overspeed and generator differential current.

9. Verifying the diesel generator operates for at least 24 hours. During the first 2 hours of this test, the diesel generator shall be loaded to greater than or equal to 7700 kW for diesel generator 12 and 3630 kW for diesel generator 13 and during the remaining 22 hours of this test, the diesel generator shall be loaded to 7000 kW for diesel generator 12 and 3300 kW for diesel generator 13. The generator voltage and frequency shall be 4160 ± 416 volts and 60 ± 1.2 Hz within 10 seconds after the start signal; the steady state generator voltage and frequency shall be maintained within these limits during this test. Within 5 minutes after completing this 24-hour test, perform Surveillance Requirement 4.8.1.1.2.d.7.a).2) and b).2)*.

10. Verifying that the auto-connected loads to each diesel generator do not exceed the continuous rating of 7000 kW for diesel generator 12 and 3300 kW for diesel generator 13.

11. Verifying the diesel generator's capability to:

    a) Synchronize with the offsite power source while the generator is loaded with its emergency loads upon a simulated restoration of offsite power,

    b) Transfer its loads to the offsite power source, and

    c) Be restored to its standby status.

12. Verifying that with the diesel generator operating in a test mode and connected to its bus that a simulated ECCS actuation signal:

    a) For Division 2, overrides the test mode by returning the diesel generator to standby operation.

    b) For Division 3, overrides the test mode by bypassing the diesel generator automatic trips per Surveillance Requirement 4.8.1.1.2.d.8.b).

13. Verifying that with all diesel generator air start receivers pressurized to less than or equal to 256 psig and the compressors secured, the diesel generator starts at least 5 times from ambient conditions and accelerates to at least 441 rpm for diesel generator 12 and 882 rpm for diesel generator 13 in less than or equal to 10 seconds.

*If Surveillance Requirement 4.8.1.1.2.d.4.a)2) or b)2) are not satisfactorily completed, it is not necessary to repeat the preceding 24 hour test. Instead, the diesel generator may be operated at rated load for one hour or until operating temperatures have stabilized.

SURVEILLANCE REQUIREMENTS (Continued)

4.8.1.1.4 The gas turbine generator system shall be demonstrated OPERABLE:

a. At least once per 15 days by verifying that all three gas turbine generators start and attain rated speed and voltage in less than or equal to 25 minutes and can be run for at least 60 minutes.

b. At least once per 31 days by verifying:

1. that all three gas turbine generators start and attain rated speed and voltage in less than or equal to 25 minutes, and

2. that the gas turbine system can be synchronized and loaded to greater than or equal to 4700 kW and can operate with this load for at least 60 minutes.

c. At least once per 31 days by verifying:

1. the fuel level in each of the three gas turbine generator day tanks,

2. the fuel level in the fuel storage tank supplying make-up to the gas turbine generator system, and

3. the OPERABILITY of the fuel transfer pump between the gas turbine generator system make-up tank and the fuel storage tank supplying make-up to the gas turbine generator system.

d. At least once every 60 days and prior to the addition of fuel to the fuel storage tank supplying make-up to the gas turbine generator system, fuel oil samples shall be drawn from the fuel storage tank supplying make-up to the gas turbine generator system and analyzed to verify that the makeup fuel oil meets the standards set forth in Specification 4.8.1.1.2.c.

Order

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ELECTRICAL POWER SYSTEMS

A.C. SOURCES - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.8.1.2 As a minimum, the following A.C. electrical power sources shall be OPERABLE:

a. One circuit between the offsite transmission network and the onsite Class 1E distribution system, and

b. Diesel generator 12, and diesel generator 13 when the HPCS system is required to be OPERABLE, with each diesel generator having:

1. A day tank containing a minimum of 220 gallons of fuel.

2. A fuel storage system containing a minimum of:

a) 48,000 gallons of fuel each for diesel generator 12.

b) 39,000 gallons of fuel for diesel generator 13.

3. A fuel transfer pump.

c. The 6200 kW gas turbine generator system consisting of 3 gas turbines, with:

1. A separate day fuel tank containing a minimum of 300 gallons of fuel for each gas turbine, and

2. A fuel storage system consisting of:

a) A makeup fuel tank containing a minimum of 300 gallons of fuel, and

b) A fuel storage tank containing a minimum of 52,000 gallons of fuel, and

c) a fuel transfer pump.

APPLICABILITY: OPERATIONAL CONDITIONS 4, 5 and *.

ACTION:

a. With all offsite circuits inoperable and/or with diesel generator 12 or the gas turbine generator system of the above required A.C. electrical power sources inoperable, suspend CORE ALTERATIONS, handling of irradiated fuel in the primary or secondary containment, operations with a potential for draining the reactor vessel and crane operations over the spent fuel storage pool when fuel assemblies are stored therein. In addition, when in OPERATIONAL CONDITION 5 with the water level less than 23 feet above the reactor pressure vessel flange, immediately initiate corrective action to restore the required power sources to OPERABLE status as soon as practical.

b. With diesel generator 13 of the above required A.C. electrical power sources inoperable, restore the inoperable diesel generator 13 to OPERABLE status within 72 hours or declare the HPCS system inoperable and take the ACTION required by Specification 3.5.2 and 3.5.3.

c. The provisions of Specification 3.0.3 are not applicable.

*When handling irradiated fuel in the primary or secondary containment.

3/4.8.1, 3/4.8.2 and 3/4.8.3 A.C. SOURCES, D.C. SOURCES and ONSITE POWER DISTRIBUTION SYSTEMS

(The following bases are developed for low power operation while diesel generator 11 is out of service for disassembly and inspection.)

The OPERABILITY of the A.C. and D.C. power sources and associated distribution systems during operation ensures that sufficient power will be available to supply the safety related equipment required for (1) the safe shutdown of the facility and (2) the mitigation and control of accident conditions within the facility. The minimum specified independent and redundant A.C. and D.C. power sources and distribution systems satisfy these systems requirements for capacity, capability, and redundancy needed for safe plant shutdown.

The ACTION requirements specified for the levels of degradation of the power sources provide restriction upon continued facility operation commensurate with the level of degradation. The OPERABILITY of the power sources are consistent with the initial condition assumptions of the accident analyses and are based upon maintaining at least Division 2 of the onsite A.C. or the gas turbine generator system and D.C. power sources and associated distribution systems OPERABLE during accident conditions coincident with an assumed loss of offsite power and single failure of the other onsite A.C. source. Division 3 supplies the high pressure core spray (HPCS) system only.

The A.C. and D.C. source allowable out-of-service times are based on Regulatory Guide 1.93, "Availability of Electrical Power Sources", December 1974. When diesel generator 12 or gas turbine generator system is inoperable, there is an additional ACTION requirement to verify that all required systems, subsystems, trains, components and devices, that depend on the remaining OPERABLE diesel generator 12 or gas turbine generator system as a source of emergency power, are also OPERABLE. This requirement is intended to provide assurance that a loss of offsite power event will not result in a complete loss of safety function of critical systems during the period diesel generator 12 or gas turbine generator system is inoperable. The term verify as used in this context means to administratively check by examining logs or other information to determine if certain components are out-of-service for maintenance or other reasons. It does not mean to perform the surveillance requirements needed to demonstrate the OPERABILITY of the component.

The OPERABILITY of the minimum specified A.C. and D.C. power sources and associated distribution systems during shutdown and refueling ensures that (1) the facility can be maintained in the shutdown or refueling condition for extended time periods and (2) sufficient instrumentation and control capability is available for monitoring and maintaining the unit status.

The surveillance requirements for demonstrating the OPERABILITY of the diesel generators are in accordance with the recommendations of Regulatory Guide 1.9, "Selection of Diesel Generator Set Capacity for Standby Power Supplies", March 10, 1971, Regulatory Guide 1.108, "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants", Revision 1, August 1977 and Regulatory Guide 1.137" Fuel-Oil Systems for Standby Diesel Generators", Revision 1, October 1979.

SAFETY EVALUATION REPORT RELATED TO ORDER REQUIRING DIESEL GENERATOR INSPECTION

GRAND GULF UNIT 1

1.0 Introduction

As a basis for operation of Grand Gulf Unit 1 at full power, Mississippi Power & Light (MP&L) submitted reports dated February 20 and April 17, 1984, concerning the MP&L program to verify and enhance the reliability of the TDI diesel generators at Grand Gulf Unit 1. These submittals were in response to the NRC questions on the TDI issue and are supplemental to other MP&L responses to the NRC requests contained in letters to J. P. McGaughy dated October 31, 1983 and December 27, 1983. Additional actions taken by MP&L to verify and enhance the reliability of onsite/offsite AC power systems were documented by letter dated February 26, 1984.

Based on a review of this information and additional information provided during meetings between the NRC staff and MP&L, the staff informed MP&L by letter dated April 25, 1984, that the staff was unable to conclude that the proposed MP&L program for ensuring adequate TDI diesel engine reliability would be sufficient to support operation of Grand Gulf Unit 1 at power levels in excess of 5% of full power. The staff proposed additional actions to ensure adequate reliability of the TDI diesels including disassembly and inspection of at least one TDI diesel, subsequent preoperational testing of that engine, and additional maintenance and surveillance actions pertaining to the TDI diesels.

By letter dated May 6, 1984, MP&L submitted additional information to support its conclusions that there is little if any justification to require a disassembly inspection of a TDI diesel engine prior to the first refueling outage, and that adequate basis exists to support 100% power operation of Grand Gulf Unit 1 until the first refueling outage. The MP&L submittal also included an alternative proposal to disassemble and inspect the Division 1 TDI diesel generator in parallel with the conduct of the plant's power ascension program.

In their submittal of February 26, 1984, the licensee proposed to use gas turbines as supplemental AC sources to the onsite distribution systems. Therefore, during the period of time when one TDI diesel generator (Division 1) is unavailable due to disassembly and inspection of diesel engine components, the available AC power sources will be the offsite systems (115 KV and 500 KV networks), one TDI diesel generator (Division 2) and the gas turbine generators. Although the Division 2 TDI diesel generator will be maintained with current Technical Specifications, our review conservatively assumed both TDI diesel generators were not available.

This safety evaluation is based on the assumption that the reactor thermal power level will not exceed 5% power while one TDI diesel generator is unavailable.

2.0 Engine Disassembly, Inspection and Pre-Operational Testing

2.1 Discussion

Concerns regarding the reliability of large bore, medium speed diesel generators of the type supplied by TDI at Grand Gulf Unit 1 and 15 other domestic nuclear plants were first prompted by a crank shaft failure at Shoreham on September 1983. However, a broad pattern of deficiencies in critical engine components have since become evident at Shoreham, Grand Gulf Unit 1, and at other nuclear and non-nuclear facilities employing TDI diesel generators. These deficiencies stem from inadequacies in design, manufacture and QA/QC by TDI.

In response to these problems, eleven U.S. nuclear utility owners, including MP&L, formed a TDI diesel generator owners group to address operational and regulatory issues relative to diesel generator sets used for standby emergency power. The Owners Group program, which was initiated in October 1983, embodies three major efforts.

1) Resolution of 16 known generic problem areas (Phase I program) intended by the Owners Group to serve as an interim basis for the licensing of plants

2) Design review of important engine components and quality revalidation of important attributes for selected engine components (Phase II program)

3) Expanded engine testing and inspection

Pending the completion of the Owners Group program, MP&L has submitted a description of its program to enhance the reliability and performance of the two TDI diesel generators. This includes engineering evaluations, testing, and corrective actions taken in response to problems experienced during the startup testing phase of the plant, and other potential generic problems identified by the TDI Owners Group (i.e., the 16 known problem areas).

2.2 Evaluation

Problems to date with TDI diesel generators stem from a broad pattern of design, manufacturing, and QA/QC inadequacies by TDI. For this reason the staff believes that the comprehensive approach of the Owners Group program to go beyond problems known to exist and to include a systematic review of critical engine components is essential for purposes of reestablishing full confidence in the reliability of the diesel engines.

Pending completion of the TDI Owners Group program, and the staff's review of the recommendations stemming from this program, the staff concludes that additional information is needed regarding the present condition of critical engine components to support interim operation of Grand Gulf Unit 1 at power levels in excess of 5% power. An engine disassembly and inspection in accordance with Section 2.2.1 below is needed to obtain the required information, and subsequent preoperational testing in accordance with Section 2.2.2 below is needed to verify that the engine has been properly reassembled. The staff's findings regarding the need for these actions are generally based on the following:

1) Phase I of the Owners Group program which addresses the 16 known problems has not been completed. To date, the Owners Group has submitted reports addressing 8 of these potential problem areas for DSRV-16 engines. However, the staff review of the available Owners Group Reports has not yet been completed, and therefore the staff is unable to conclude that a final resolution to these potential problem areas is available. In addition, some of the Owners Group reports call for NDE inspections of components which have not yet been performed for GGNS (See Item 4 below).

2) Owners Group Phase I reports still outstanding on the DSRV engines include reports on the connecting rods and the cylinder block. Little information has been provided to date regarding the specific causes of failures and/or cracks of these components.

3) The Owners Group has not completed Phase II of its program consisting of a comprehensive design review and quality reverification of important engine components.

4) Verification (post-operational) NDE inspections have not been performed on a number of critical components originally included in the list of 16 known potential problems. These include:

   - pistons
   - connecting rod bearings
   - connecting rods
   - wrist pin bushing
   - engine block
   - turbocharger thrust bearing

   To date, these and other important engine components have experienced between 200 and 800 hours of service (for Div. 1 engine). Confirmation that these components are presently in an acceptable condition will provide needed confidence that these components will not cause an engine failure during the next 50 to 200 hours of anticipated engine running time before the first refueling outage. (It is anticipated that the Owners Group program and the staff findings stemming from its review of the program results will be complete by that time.)

5) Because of QA/QC deficiencies at TDI, the staff believes there may be significant differences in the "as manufactured" quality of engine components between the TDI engines at Grand Gulf and those of other plants with similarly designed engines. Therefore, it is difficult to draw conclusion relative to the Grand Gulf engines based on inspection results from other plants (e.g., Catawba).

2.2.1 Engine Disassembly and Inspection

The Division 1 engine (which has accumulated the most operating hours to date) should be disassembled for inspection of key components (identified below), prior to plant operation above 5% power. Action to be taken on the Division 2 engine would be contingent upon the results of the inspections conducted on the Division 1 engine and MP&L's ability to demonstrate, through a review of the manufacturer's QA records, that the two engines have similar "as-manufactured" quality.

The types of inspections to be performed should be similar to those conducted at Shoreham and Catawba (e.g., dye penetrant, eddy current, ultrasonic, radiography, etc.) as appropriate for each component based on the kinds of problems (e.g., cracks, abnormal wear or other distress, inadequate assembly or torquing) which have previously been experienced on these components at Grand Gulf Unit 1, Shoreham or other TDI engines. The staff concludes that the type and scope of inspections proposed by MP&L in their May 6, 1984 submittal (Table 1 of Attachment 2 to the Order) would be acceptable subject to the changes in Table 2 of Attachment 2 to the Order. All defective parts found shall be replaced prior to declaring the engine operable. The engine block and engine base may be excepted if indications are non-critical. Non-critical indications are defined as not causing oil or water leakage, not propagating, or not adversely affecting cylinder liners or stud holes.

A description of the inspections performed and the results should be submitted for NRC staff review prior to plant operation above 5% power. This report should address all indications found and the engineering basis for acceptance or rejection of the subject components.

2.2.2 Preoperational Testing Subsequent to Engine Disassembly and Inspection

Preoperational testing must be performed on the Division 1 engine following its disassembly, inspection and reassembly. In addition to adhering to the manufacturer's preoperational test recommendations, this phase of testing should include the elements listed below, if they are not already included in the manufacturer's recommendations, unless they would not be recommended by the manufacturer in order to satisfy operability requirements.

- 10 modified starts to 40% load
- 2 fast starts to 70% load
- 1 24-hour run at 70% load

A modified start is defined as a start including a prelube period as recommended by the manufacturer and a 3 to 5 minute loading to the specified load level and run for a minimum of one hour. The fast starts are "black starts" conducted from the control room on simulation of an ESF signal with the engine on ready standby status. The engine should be loaded to 70% and run for 4 hours at this load on each fast start test. The 24-hour performance run is suggested to detect abnormal temperatures and/or temperature excursions that might indicate engine distress. Either a modified or fast start may be utilized.

Should these tests not be performed satisfactorily at the first attempt, i.e., the 10 modified starts should be performed with no failure, the NRC staff will review the need for additional testing requirements. A failure is defined as an inability of the engine to start, or an abnormal condition during the respective run which would ultimately preclude the engine from continuing to operate.

2.2.3 Engine Maintenance and Surveillance Program

The staff will review MP&L's proposed maintenance, surveillance and inspection program as identified in MP&L's May 6, 1984 submittal prior to the issuance of a license for plant operation in excess of 5% power.

2.3 Conclusion

Pending the completion of the TDI Owners Group Program and the staff review of recommendations stemming from this program as they apply to Grand Gulf Unit 1, the staff concludes that a TDI diesel generator disassembly and inspection in accordance with Section 2.2.1 of this SER and subsequent pre-operational testing of the affected engine(s) in accordance with Section 2.2.2 of this SER is needed to support operation of Grand Gulf Unit 1 at power levels in excess of 5% of full power. The staff will review MP&L's proposed maintenance, surveillance and inspection program and any needed license conditions prior to issuance of a full power license.

3.0 Interim Technical Specifications for AC Power Systems

3.1 Review Scope

We have reviewed the description of the 500 KV and 115 KV transmission lines, and the gas turbine generator set connected to the offsite system and evaluated their capacity, capability, reliability and redundancy. We have also reviewed the proposed technical specifications for AC power systems.

3.2 Offsite Power

The offsite power system has previously been reviewed in the Safety Evaluation Report of the FSAR and was found to satisfy the capacity, capability, reliability and redundancy requirements and, therefore, is acceptable.

3.3 Gas Turbine Generator

The gas turbine generators (GTG) are presently installed at Grand Gulf near the Unit 2 diesel fuel oil storage tanks. This location will provide an advantageous electrical connection to the non-Class 1E portion of the Unit 1 plant distribution system. The three units are connected in parallel through their associated circuit breaker to the non-Class 1E 4160-volt distribution system which in turn feeds the Class 1E 4160-volt buses. In view of the physical location of the gas turbines surrounded by large substantial structures it is highly unlikely that a tornado would damage the gas turbine simultaneously with both the 115 KV and the 500 KV offsite power sources. Therefore the gas turbine power source is expected to be available to the onsite distribution system to provide power to the safe shutdown loads for a tornado event which may damage the offsite power sources. Also, the location will prevent unavailability of the gas turbines due to flooding and normal standing water conditions.

The gas turbine generator set consists of three units. Two units have a capacity of 2000 KW each and third unit has a capacity of 2200 KW. Our review found that, of the three units, the combined two units, aggregate rating of 4000 KW, are sufficient to provide power to safe shutdown divisional loads of 3200 KW for long term cooling.

Each gas turbine has a separate auxiliary power unit (APU) for starting. A single APU can be used to start any one of the gas turbines. The gas turbine is designed for manual dead-line starting capability: i.e., the gas turbine is capable of starting and accelerating to rated speed and voltage by using an APU. After bringing all three units up to rated speed and voltage, the first unit's circuit breaker closes to a dead bus and the second and third units are synchronized in sequence to the first unit and thus become ready to provide power to the bus.

To demonstrate this capacity and starting capability following initial testing, the licensee will perform periodic tests which require that (1) at least once every 15 days, each GTG will be started, brought to rated speed and voltage, and run for at least 60 minutes; (2) at least once every 31 days, ~~two of~~ the GTG will be started, synchronized and loaded to 4700 KW in less than or equal to 25 minutes and operated with a load greater than or equal to 4700 KW for at least 60 minutes. The periodic tests and the interim surveillance requirement for the gas turbine generator in the proposed technical specification are equivalent to those for the emergency standby power supplies. We believe that these surveillance requirements on the gas turbine power supply are adequate for the period of time when one of TDI diesel generators is being inspected.

See Table 8.3.1.1-1 4.8.1.1.4 years 3/4 8-7c

3.4 Technical Specifications

i) The current surveillance requirements and limiting conditions for operation (LCOs) for the offsite power sources and diesel generator No. 12 (DG #12) and diesel generator No. 13 (DG#13) remain the same.

ii) Surveillance requirements as stated in Section 3.3 of this evaluation and LCOs for the gas turbine generators are included in the interim technical specifications. (Attachment 3 to this Order)

iii) Additional operability requirements for DGs #12, #13, and GTGs during tornado warning and watch conditions are also included in the interim technical specifications.

4.0 Overall Conclusion

The NRC staff, in attachment 1 to this Order, had concluded that total failure of the TDI diesels at Grand Gulf would not significantly increase the risk of the low power operation and that the risk is acceptably small. Nevertheless, the licensee has provided gas turbine generators to substitute for the out-of-service diesel generator during the period of inspection and subsequent preoperational testing.

Based on our evaluation of the available power sources and in view of the minimum power needs for low power operation, the staff finds that these sources (offsite, one TDI diesel and gas turbine generators) together with the specified surveillance requirements, represent a power system which has the capacity, capability, reliability, and redundancy for this low power level and that the health and safety of the public will not be endangered by implementation of this Order.