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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

DESIGN REPORT FOR STATION BLACKOUT/ELECTRICAL SAFEGUARDS UPGRADE PROJECT

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

DOCKET NOS. 50-282/306

1.0 INTRODUCTION:

Northern States Power (NSP) has proposed a Station Blackout/Electrical Safeguards Upgrade (SBO/ESU) program at Prairie Island Nuclear Generating Plant (Prairie Island). The SBO/ESU program addresses the addition of two new emergency diesel generators (EDG) including construction of a new EDG building, installation of new electrical distribution equipment and modification of Cooling Water Pump No. 121 to become a swing safeguards pump.

NSP is planning to add two addition EDGs and upgrade the 4kV and 480V electrical safeguards distributions systems. The plant presently has two EDGs shared between two units. The purpose for adding the two EDGs and upgrading the electrical systems at Prairie Island is to provide dedicated redundant emergency ac power sources for both Unit 1 and Unit 2. Also, Prairie Island is taking actions to change the SBO coping duration from an 8-hour to a 4-hour category. When the upgrade is completed, Unit 1 will provide an alternate ac power source for Unit 2 (and vice versa) under station blackout (SBO) conditions.

NSP, by letter dated November 27, 1990, submitted a Design Report for the upgrade and committed to submit at a later date a License Amendment Request containing the Safety Analysis, proposed Technical Specification Changes and the Significant Hazards Analysis. By a letter dated March 20, 1991, the licensee provided additional information to clarify several questions related to the SBO/ESU program.

The staff has reviewed the NSP submittals on this subject, and our evaluation is documented below:

2.0 EVALUATION:

The staff evaluation is based on the review of NSP submittals dated November 27, 1990, and March 20, 1991, and several phone discussions with the licensee on this subject. The primary objective of the SBO/ESU program is to implement plant modifications that are necessary to comply with the SBO rule and to improve the reliability and availability of the onsite emergency sources.

The existing Prairie Island Units 1 & 2 have two EDGs, D1 and D2, shared between the two units (multi-units sharing onsite emergency and shutdown ac electric system). At present each EDG is a back up to the preferred offsite ac source and is capable of sequentially starting and supplying the power requirements of one complete set of engineered safety features for one unit during accident conditions (LOOP concurrent with LOCA) while providing power to the second unit to be placed in a safe shutdown (LOOP condition).

Two new EDGs, D5 and D6, will be installed at Prairie Island and will be used as dedicated emergency ac power sources for Unit 2, and as an alternate ac (AAC) source for Unit 1 to meet the SBO rule. The existing D1 and D2 EDGs will serve as dedicated emergency ac power sources for Unit 1 and as an AAC source for Unit 2 for meeting the SBO rule.

The D5 and D6 units will be composed of tandem-engine diesel generators. The two engines in each set will be directly coupled to a dual bearing generator, one on each end in a back-to-back arrangement. Each new EDG is rated at 5400kW continuous (8750 hours basis), 0.8 power factor, 1200 RPM, 4160 volt, 3 phase, 60 Hertz. The two engines are identical except for the camshaft drive trains which provide clockwise rotation for one engine and counter clockwise rotation for the other as required by the back-to-back arrangement. The capacity of the EDGs proposed as onsite ac emergency power (EDGs D5 and D6) for Unit 2 is adequate with ample margin to provide power for the Cooling Water Pump No. 121 and addition of future loads.

The new EDGs instrumentations and controls are supplemented by a non-safety related computer monitoring unit located in the diesel generator control room. It includes a PC based data acquisition system capable of collecting, storing and processing analog and digital input signals from sensors in the diesel generator unit and auxiliary systems. The system is capable of monitoring operating parameters, interfacing with the plant computer, providing historical file and trending for accurate prediction of preventative maintenance needs. This computer monitoring system will be used for the new D5 and D6 EDGs only.

The mode of operation of each new EDG (D5 and D6) is determined by the position of the EDG selector switch (normal or maintenance):

1. The "Normal" mode will allow automatic start, manual emergency start or test of the EDG. These operating functions can be initiated from the EDG control room "Local" or Main Control Room "Remote" by using the "Local-Remote" selector switch.

   In the "Automatic" start mode the EDG starting can be initiated automatically by either a bus undervoltage and/or SI signal or by "Emergency Manual" start. The EDG will accelerate to rated speed and reach rated voltage within ten (10) seconds from receipt of the starting signal (FAST START). A Safeguards (SI), or Emergency Manual start will block all the engine and generator trips except manual emergency stop, generator differential, and engine overspeed.

   In the "Test" mode, the EDG may be started and stopped by using a manual "Start-Stop" test switch. Operator selected two acceleration rates are available: Slow and Fast. In "SLOW" start mode the acceleration time is approximately twice that of the "FAST" start mode.

2. In the "Maintenance" selection position, operations of the EDG are similar to the "Test" mode with the following exceptions:

   a. Individual operation of either engine 1 or 2 through the use of the diesel engine selector switch when the generator is decoupled.

   b. Hydraulic or electric governor operation.

   c. EDG will not respond to an emergency start signal while in "Maintenance" mode.

   d. Maintenance operation can only be initiated from the EDG Control Room by way of key-locked selector switch.

   e. Field flashing circuit requires manual operation.

The electrical system upgrading will reassign the existing EDG D1, presently being the power source to Train A Safeguards System of both units to Unit 1 Train A safeguards. Similarly existing EDG D2 will be reassigned to supply power to Unit 1 Train B Safeguards. Thus the two EDGs (D1 and D2) will be aligned as the onsite emergency ac power sources for Unit 1. The two new EDGs (D5 and D6) will be aligned as the onsite emergency ac power sources for Unit 2 (EDG D5 will supply Train A Safeguards and EDG D6 will supply Train B Safeguards). The two existing Unit 2 load sequencer will be replaced with two new qualified sequencers. The two new EDGs will be installed in a new Seismic Category 1 structure which will house also the support equipment and new electrical switchgear for Unit 2.

In conjunction with the addition of two EDGs, the electrical safeguards 4kv and 480 volts distribution systems will be upgraded/modified as follows:

o Replacement of 4kV safeguards buses in Unit 2 and expansion of 4kV safeguards buses of Unit 1.

o Replacement of and provision for alternate feeds for 480V safeguards buses in Units 1 and 2.

- Improvement in voltage regulation, principally at the 480V level, in Units 1 and 2.

- Improvement in circuit coordination by eliminating subfed 480V Motor Control Centers (MCCs) on safeguards buses.

Two new 4160V switchgear lineups will be located in the new Seismic Category I D5/D6 building. The present Unit 2, 4160V safeguards loads will be reconnected to the new Unit 2 safeguards switchgear.

A new additional 4160V safeguard switchgear will be installed in the D5/D6 building to allow powering of the Cooling Water Pump No. 121 from Unit 2, 4160V switchgear train A or Train B (D5 or D6 EDG). The pump motor will be upgraded to Class 1E which will increase the availability of the Cooling Water system and provide the basis to chang Limiting Condition of Operation (LCO). Presently the LCO requires the shutdown of both units in the event of extended inoperability of one of the safeguards diesel driven cooling water pump.

The two existing Unit 1, 480V safeguards buses will be replaced with four new safeguard buses. One of the buses will occupy the vacated Unit 2, 480V switchgear room. The second bus will occupy the existing Unit 1, 480V switchgear room. The two additional buses will be located in the present Unit 2, 4160V switchgear rooms. The resulting Unit 1 configuration, two buses per train, will be similar to Unit 2 configuration.

Four new Unit 2, 480V safeguards buses (two per train) will be installed in the new D5/D6 Building to replace the two existing buses. The present Unit 2 safeguards loads (MCCs), plus additional D5/D6 and building safeguards loads will be divided between the buses to improve the voltage regulation on the 480V safeguards buses. Automatic voltage regulators will be added to each of the Unit 1 and Unit 2, 480V safeguards buses (8 total) to improve voltage regulation.

Alternate power sources from the same train of the opposite unit, to be used primarily during maintenance outages on 4160V source buses, will be added to the 480V safeguards buses. Each alternate source line-up will consist of an incoming line compartment, a 4160-480V transformer section and a transition section for connection to the 480V switchgear. One alternate source line-up per train will be provided to be used by either or both 480V safeguards buses. Loading on the alternate source transformer will be administratively controlled.

As part of the SBO/ESU program, the main control board and the plant control room simulator will be modified to reflect the additions of the EDG and the upgrading of the electrical switchgear. The existing control room "G" panel will be replaced by a new "G" panel to accommodate all instrumentation and controls of EDG 5, EDG 6, and of the additional electrical switchgear. To reflect the new upgrade, the software of the simulator and of the emergency Response Computer System simulator will also be modified.

The objectives of the SBO/ESU program are to implement those plant modifications and software elements that are necessary to comply with the SBO and to improve the reliability of the onsite ac emergency sources. The objectives are:

- Achieve for the SBO a four hour coping duration per NUMARC 87-00.

- Achieve AAC availability within 10 minutes or if not possible, one hour by utilizing the safeguards diesel generators as AAC power for the other unit.

- Update the coping analysis to reflect the actual design for the new diesel generators.

Additional benefits of this upgrade are:

1. Eliminate sharing emergency diesel generators between units.

2. Reduce the loss of onsite ac power contribution to core melt risk.

3. Eliminate the two unit shutdown exposure caused by the present diesel generator Limiting Condition for Operation (LCO).

4. Provide increased emergency on-site power margin as well as margin for future loads.

5. Provide power to Cooling Water Pump No. 121 to reduce two unit shutdown exposure caused by the Cooling Water System LCO.

6. Provide integrated planning, design and installation for diesel generator plant interface.

NSP confirmed that within the existing plant boundary, the existing design criteria as defined in Prairie Island Updated Safety Analysis Report (USAR) will apply. However, for Position C3 of Regulatory Guide 1.81, Revision 1, "Shared Emergency and Shutdown Electrical Systems for Multi-Unit Nuclear Power Plants," the licensee confirmed that the onsite emergency ac electrical system for each unit will be separate and independent, but the capability to interconnect the emergency (safeguards) 4kV ac buses within separation criteria divisions (i.e., Unit 1 Train A to Unit 2 - Train A, etc.) will be retained for use during Station Blackout. This is acceptable as it is in conformance with the SBO rule allowing single cross-tie connections to either AAC source.

3.0 CONCLUSION

Based on the evaluation discussed above, the staff agrees that the SBO/ESU will provide an increased safety benefit and bring the Prairie Island plant onsite ac emergency power sources to the same level as other 2-unit sites with four diesels. The two new EDGs will be dedicated to Prairie Island Unit 2. The upgrade/modification of 4 kV and 480 volts safeguards distribution system will improve the overall electrical design of Prairie Island. It is a good enhancement of the onsite electrical ac emergency power and is an amelioration of the operation of Prairie Island as it is eliminating the sharing of the two EDGs between two units. The use of a computer based monitoring system for the new EDGs 5 and 6 will improve and enhance the operators capabilities to monitor the operating parameters and event sequencing of the new EDGs as well as allowing accurate prediction of the preventative maintenance needs for the new diesels.

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ENCLOSURE 3

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REVIEW OF THE LOAD SEQUENCERS SAFEGUARDS AND VOLTAGE REGULATORS IN THE UPGRADE

STATION BLACKOUT/ELECTRICAL SAFEGUARDS UPGRADE PROJECT

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NOS. 1 AND 2

FACILITY OPERATING LICENSE NOS. DPR-42 AND DPR-60

NORTHERN STATES POWER COMPANY

DOCKET NOS. 50-282 AND 50-306

1.0 INTRODUCTION

By letters dated November 27, 1990, July 10, 1991 and October 24, 1991, Northern States Power Company (NSP) submitted descriptions of a proposed Station Blackout/Electrical Safeguards Upgrade Project for the Prairie Island Nuclear Generating Plant, Units 1 & 2. The Instrumentation and Control Systems Branch (SICB) reviewed the use of programmable logic controllers (PLCs) in the station blackout/electrical safeguards system (SBO/ESS) load sequencers and voltage regulators.

To enhance the SBO/ESS, NSP proposed the addition of two EDGs to Prairie Island existing station emergency power supplies, which presently consists of two EDGs shared between Units 1 and 2.

The SBO/ESS enhancement includes the replacement of the four existing Unit 1 and 2 load sequences with four new computer-based load sequencers, and the addition of automatic solid-state programmable logic controller-based voltage regulators to each of the Unit 1 and Unit 2 480 volt safeguards buses to improve voltage regulation. The load sequencers and voltage regulators utilize Allen-Bradley commercial grade PLCs to execute the control functions and provide continuous monitoring of the load sequencer and voltage regulation functions.

The use of commercial grade PLCs and the use of software for emergency applications requires assurance that these PLCs are qualified as Class 1E, and will provide for the safe operation of the plant. SICB staff reviewed the licensee's documentation (Reference 1) and requested additional information (RAI) to clarify several design details (Reference 2). The following evaluation is based upon the licensee's initial submittal and their response to the RAI (References 3 and 3a).

2.0 EVALUATION

The voltage regulators and the load sequencer system consists of redundant trains with each train dedicated to an Emergency Diesel Generator (EDG). A cross-tie connects the emergency power supplies in the two nuclear plants to ensure availability of an EDG during a loss of offsite power (LOOP) in one unit. Additionally, the licensee has provided battery back-up (UPS) capabilities, and manual access to the load sequencers and voltage regulators. This degree of redundancy and diversity is acceptable.

A new load sequencing system and voltage regulators are to be installed in the upgrade. Spectrum Technologies, Inc. (STI), a subcontractor to the SBO/ESS prime contractor, Fluor Daniel, is developing the software for the load sequencers and voltage regulators. The STI Verification and Validation (V&V) plan satisfactorily follows the guidelines in NUREG/CR-4670, 8/87, "Handbook of Software Quality Assurance Techniques Applicable to the Nuclear Industry" (Refernce 4), and ANSI/IEEE-ANS-7.4.3.2-1982, "American National Standard, Application Criteria for Programmable Digital Computer Systems in Safety Systems of Nuclear Power Generating Stations" (Reference 6) which is endorsed by Reg Guide 1.152 (Reference 5). The licensee contractor's documentation describing the PLC, and load sequencer and voltage regulator logic will be provided to the licensee upon delivery by the contractor. Additionally, the licensee and A/E have reviewed and commented on the vendor's software specification design description and ladder logic diagram, and will witness the contractor's integrated systems tests to ensure its compliance with the licensee's specifications for Class 1E voltage regulator and load sequencer system.

The verification phase of the licensee's V&V plan addresses verification of hardware requirements, software requirements, software design, software implementation, and hardware/software integration. System validation will consist of preparation and independent verification of test procedures, execution of the tests, and documentation with independent verification of the test results. The licensee and A/E have reviewed and commented on the vendor's PLC software acceptance test procedure. The staff will audit the PLC V&V program and site test documentation as part of a post-installation system audit.

The licensee will qualify the PLCs as Class 1E through the vendor's dedication of the commercial grade equipment. The licensee's QA organization has performed an audit of the vendor's QA program which included a review of the contractor's procedures for commercial dedication of the PLCs. The dedication will be in accordance with Generic Letter 89-02, "Actions to Improve the Detection of Counterfeit and Fraudulently Marketed Products," (Reference 7) and Generic Letter 91-05, "Licensee Commercial-Grade Procurement and Dedication Programs" (Reference 8). Both Generic Letters endorse the guidance provided in a report issued by the Electric Power Research Institute (EPRI), EPRI NP-5652, "Guideline for the Utilization of Commercial Grade Items in Nuclear Safety Related Applications (NCIG-07)", (Reference 9). The staff will audit the results of the PLC commercial grade equipment dedication to ensure the licensee addresses Criteria III, IV, and VII of Appendix B to 10 CFR Part 50.

The staff requested that the licensee provide a discussion of the acceptance criteria for verifying control cabinet instruments and logic. The licensee states that the control cabinet instruments and control logic functions will be fully tested during the verification and validation testing phases. This will include module testing and integrated testing. Additionally, the licensee will test load sequencer and voltage regulator response to simulated plant events.

The tests to be performed will address the following scenarios:

1. Safety injection followed 30 seconds later by a uegraded voltage,
2. Safety injection with a simultaneous loss of offsite power, and
3. A loss of offsite power.

The load sequencing and voltage regulating function is t.e same for all transient scenarios; consequently, the staff find these tests to be adequate for ensuring operability.

The licensee states that, in addition to the regularly scheduled EDG startup and bus loading tests, the load sequencer and voltage regulating function will be tested from input signals through the logic and counter states, relay drivers, and continuity through the relay ... on a monthly interval. The licensee states that, in the event a plant t...ent occurs during the testing period, the load sequencer and voltage regulator will change from test mode into operating mode and begin loading buses in approximately 250 milliseconds. The licensee further states that, in addition to the above tests, during preoperational testing, power will be removed from the PLC and all programmable functions will be verified to function per design requirements upon restoration of power to the PLCs. The staff finds this test program and test sequence interruption time to be acceptable.

A watchdog timer is built into the voltage regulator and load sequencer system, such that a loss of function is annunciated in the main control room. The watchdog timer monitors the proper functioning of software events that occur periodically. The licensee states that the operating procedures are being revised to incorporate manual actions to respond to an annunciated problem and to bypass a failed load sequencer or voltage regulator to allow stripping the bus, starting the EDG, and loading onto the bus the equipment necessary for safe plant shutdown.

Because the time required to manually load the required buses upon failure has not changed from the previous design, the staff finds the manual override provisions and the method of detecting and annunciating problems to be acceptable. There will be six annunciators in the Control Room including; tr..le, under-voltage, failure, and out-of-service. Using RG 1.47 (Reference 10) as a guideline, the staff will audit the licensee's method of providing the control room operators with bypass indications and inoperable state indications.

The PLCs contain on-board battery back-up capable of retaining all stored program data in the random access memory (RAM) through a continuous power outage of 12 months. The licensee will inspect the condition of the batteries every refueling outage, and replace the batteries as needed. The staff finds this configuration and battery maintenance practice to be acceptable.

The PLCs use electrically erasable programmable read only memory (EEPROM) modules for nonvolatile storage of the PLC programs. The EEPROM is used to download the PLC operating program to the PLC RAM following recovery from loss of PLC power if the battery backup has not maintained RAM in a power-on state. When power is restored to the PLC, the operational software will determine whether RAM has been corrupted, and either download from EEPROM or continue PLC operation. The staff finds this configuration to be acceptable.

The licensee states that the operator can manually control the load and source breakers by placing the control switch on the main control board to the MANUAL position. This capability for manual control is acceptable.

The PLC vendor, Allen-Bradley, performed NEMA Noise Susceptibility tests in accordance with NEMA ICS 2, Part 2-230, and NEMA ICS 3, Part 3-304.42. These tests subject the equipment to electrical noise that is commonly produced by electrical contacts interrupting inductive loads. Additionally, a Surge Transient Test was performed by Allen-Bradley in accordance with IEEE 472-1974 (ANSI C37.90a-1974). This test subjects the equipment to the type of electrical spikes that are generated by switching relays.

The licensee states that Allen-Bradley performed two tests: a Radiated Electromagnetic Susceptibility test in accordance with SAMA Standard PMC 33.1-1978 and IEC Standard 801-3, Edition 1, 1984; and a Conducted Electromagnetic Susceptibility test for line-connected equipment in accordance with MIL-STD-461/462, tests CS01, CS02, and CS06 for Class A3 equipment. The tests subjected the PLCs to frequencies of 30 Hz to 1 GHz, with a field strength of 10 V/m. This range of frequencies envelops typical radio frequencies for portable two-way radios, which have field strengths less than 10 V/m. Consequently, the staff finds the proposed qualification program for electromagnetic interference and radio frequency interference to be acceptable. The licensee will verify and have available for audit verification that the electromagnetic environment qualification at the plant is enveloped by the vendor's tests.During the site audit, the staff will ensure that the vendor's tests envelop the EMI and RFI environment of the installed equipment.

The licensee states that the non-1E systems interfacing with the PLC are the inputs to the plant computer through a remote multiplexer unit, inputs to the annunciator system, and contacts to the main control board indicating lights. These non-1E interfaces are isolated from the PLC with coil to contact and contact to contact isolation relays. These forms of isolation are acceptable. The staff will verify the non-1E isolations during the site audit.

The licensee states that the NSP Electrical Systems Engineering group will be responsible for configuration control, in accordance with the Prairie Island Quality Assurance Manual. Changes to the load sequencer and voltage regulators after installation will be in accordance with the licensee's Uniform Modification Process, including 10 CFR 50.59 evaluations. The staff finds this to be an acceptable means of ensuring configuration control.

3.0 CONCLUSION

Based on the above evaluation, the SICB staff find the instrumentation and control systems aspects of the Prairie Island voltage regulators and load sequencer system to be acceptable. The licensee has committed to a formal verification and validation (V&V) program, augmented by extensive testing of both the hardware and software. The V&V program satisfactorily follows the guidelines in

NUREG/CR4670, 8/87, "Handbook of Software Quality Assurance Techniques Applicable to the Nuclear Industry", and ANSI/IEEE-ANS-7.4.3.2-1982, which is endorsed by RG 1.152.

Additionally, the licensee will verify that the PLC electromagnetic environment at the plants is enveloped by the vendor's tests, and have this information available at the plant site or the licensee's offices for NRC staff audit. The non-1E systems are isolated from the PLC with coil to contact and contact to contact isolation relays. These forms of isolation are acceptable. The staff will verify the non-1E isolations during the site audit.

The licensee states that the NSP Electrical Systems Engineering group will be responsible for configuration control, in accordance with the Prairie Island Quality Assurance Manual. Changes made after installation will be in accordance with the licensee's Uniform Modification Process, including 10 CFR 50.59 evaluations. The staff finds this to be an acceptable means of ensuring configuration control.

To ensure the acceptability of implementation, the staff will audit the following for the load sequencer and voltage regulators:

1) Software and hardware modifications to determine the acceptability of the V&V program,

2) Isolation of non-1E systems from the Class 1E systems,

3) Dedication of commercial grade components,

4) Verification that the electromagnetic environment qualification at the plant is enveloped by the vendor's tests, and

5) The licensee's method of providing the control room operator with bypass indications and inoperable state indications.

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References:

1) Letter from Northern States Power Company to U.S. Nuclear Regulatory Commission dated November 27, 1990, "Design Report for the Station Blackout/Electrical Upgrade Project."

2) Letter from U.S. Nuclear regulatory Commission to Northern States Power Company dated June 6, 1991, "Request for Additional Information - Station Blackout/Electrical Safeguards Upgrade Project (TAC Nos. 68588/68589)."

3) & 3a Letter from Northern States Power Company to U.S. Nuclear Regulatory Commission dated July 10, 1991, and October 24, 1991, "Reply to Questions on Design Report for the Station Blackout/Electrical Safeguards Upgrade Project (TAC Nos. 68588/68589)."

4) NUREG/CR-4670, 8/87, "Handbook of Software Quality Assurance Techniques Applicable to the Nuclear Industry."

5) Regulatory Guide 1.152, "Criteria for Programmable Digital Computer System Software in Safety-Related Systems of Nuclear Power Plants," U.S. Nuclear Regulatory Commission, November, 1985.

6) ANSI/IEEE ANS-7.4.3.2-1982, "American National Standard, Application Criteria for Programmable Digital Computer Systems in Safety Systems of Nuclear Power Generating Stations."

7) Generic Letter 89-02, "Actions to Improve the Detection of Counterfeit and Fraudulently Marketed Products," U.S. Nuclear Regulatory Commission, March 21, 1989.

8) Generic Letter 91-05, "Licensee Commercial-Grade Procurement and Dedication Programs," U.S. Nuclear Regulatory Commission, April 9, 1991.

9) EPRI NP-5652, "Guideline for the Utilization of Commercial Grade Items in Nuclear Safety Related Applications (NCIG-07)," Electric Power Research Institute, June, 1988.

10) Regulatory Guide 1.47, "Safety System Status Monitoring for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, May, 1973.

ENCLOSURE 4

SAIC-91/6664

TECHNICAL EVALUATION REPORT

STANDARD REVIEW PLAN COMPLIANCE EVALUATION FOR

NEW EMERGENCY DIESEL GENERATORS AT

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

TAC Nos. 80659 and 80660

SAIC

Science Applications International Corporation

An Employee-Owned Company

Final

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TECHNICAL EVALUATION REPORT

STANDARD REVIEW PLAN COMPLIANCE EVALUATION FOR
NEW EMERGENCY DIESEL GENERATORS AT
PRAIRIE ISLAND NUCLEAR GENERATING PLANT

1.0 INTRODUCTION

This Technical Evaluation Report (TER) documents the results of a review performed by Science Applications International Corporation (SAIC) on behalf of the NRC Plant Systems Branch (SPLB) of the Design Report for the Station Blackout Electrical Safeguards Upgrade Project, Revision 1, (References 1 and 2), submitted to the NRC by the Northern States Company, Prairie Island Generating Plant.

The primary objective of the Station Blackout/Electrical Safeguards Upgrade (SBO/ESU) program at Prairie Island is to implement plant modifications necessary to comply with the final NRC rule on Station Blackout (10 CFR 50.63). This will be accomplished by the addition of two new emergency diesel generators. The new generators will serve as a dedicated source of emergency power for Unit 2 and as an alternate AC power source for Unit 1. The two existing diesel generators will serve as dedicated emergency AC power for Unit 1 and as an alternate AC power source for Unit 2. The new diesel generators, the associated panels, auxiliary equipment, electrical distribution equipment, fuel oil day tanks and lube oil tanks, will be housed in a new building to be constructed for this purpose.

The purpose of this review is to assess the compliance of the design, construction and installation of the diesel generators' auxiliary systems with the regulatory requirements of 10 CFR 50 reflected in the review process and acceptance criteria included in NUREG-0800 (Reference 3), Standard Review Plan (SRP), Sections 9.5.4 through 9.5.8. These auxiliary systems, for which SPLB has primary review responsibility, include:

(1) The diesel engine fuel oil storage and transfer system,

(2) The diesel engine cooling water system,

(3) The diesel engine starting system,

(4) The diesel engine lubrication system, and

(5) The diesel engine combustion air intake and exhaust system.

The evaluation also includes the emergency ventilation system of the new generator building, which houses the new diesel engines and the associated auxiliary systems.

In addition, the adequacy of the fire protection in the diesel generator area was evaluated against the recommendations and guidelines of Branch Technical Position (BTP) CMEB 9.5.1, "Guidelines for Fire Protection for Nuclear Power Plants" (Reference 7).

2.0 EVALUATION

2.1 Diesel Engine Auxiliary Support Systems

All components of the diesel engine auxiliary systems, that are required to operate during a design basis accident are designated as Seismic Category I and are designed and constructed to withstand a safe shutdown earthquake (SSE). The diesel engine and its engine-mounted and separately skid-mounted portions of the auxiliary support systems piping and components, normally furnished with the diesel generator package, are designed to Seismic Category I requirements. The qualification of the emergency diesel generator package supplier, SACM of France, has been the result of an extensive effort documented in "SACM Diesel Generator Qualification Report, Revision 0", submitted to the NRC as an attachment to a September 29, 1989, letter entitled "Project for the Addition of Two Emergency Diesel Generators" (Reference 6). This qualification was found acceptable by an NRC letter dated January 31, 1990.

The diesel generators and their auxiliary support systems, including the diesel fuel oil storage tanks, will be housed in the new seismic Category I diesel generator building, and the attached underground fuel oil storage vaults that provide protection from the effects of tornado, tornado missiles and floods. It has been verified that these structures are located outside of the turbine missile trajectories defined in the Prairie Island UFSAR, thus, the auxiliary systems are not subject to turbine missiles. The diesel generators are each surrounded by reinforced concrete barriers 12 to 20 inches thick. The redundant trains, of the auxiliary support systems, are separated by these barriers.

The only system in the building which includes high energy lines is the diesel generator air start system. The applicant evaluated the system against the guidance of NUREG-0800, SRP Sections 3.6.1 and 3.6.2., and BTP MEB 3-1, according to which breaks need not be postulated in piping runs of nominal piping size less than one inch. The air start piping runs for the new diesel generators are less than one inch in diameter and therefore high energy pipe breaks need not to be considered in the design.

Based on the above, the design meets the recommendation and guidance of Regulatory Guides (RG) 1.115 and 1.117, as they relate to the protection of structures, systems, and components important to safety from the effects of turbine and tornado missiles. Therefore, the design meets the requirements of General Design Criteria (GDC) 2 and 4.

The diesel generator building for each unit, at the Prairie Island Nuclear Generating Plant, is separate. Also, there are no support systems to the auxiliary systems for the new diesel generators which are shared by the two plant units. Therefore, the requirements of GDC 5 are not applicable.

Northern States Power Company has established, and is implementing an Operational Quality Assurance (QA) Plan to govern operation and modification activities of the Prairie Island Nuclear Plant. The Operational QA Plan describes, in general terms, compliance with 10 CFR 50, Appendix B, and has been reviewed and found to be acceptable by the NRC QA Branch. Design and selected safety related and non-safety related procurement activities for the project will be performed by Fluor Daniel Inc., using its QA program, which was evaluated against 10 CFR 50, Appendix B by Northern States Power. The balance of procurement activities will be performed by Northern States Power Company under the plant QA procedures. The diesel generator supplier is required, by contract, to apply a QA program meeting the requirements of 10 CFR Part 50, Appendix B.

Prairie Island has not committed to comply with NUREG/CR-0660 regarding reliability and maintenance of the diesel generators. However, the applicant is monitoring industry progress with regard to guidance for implementing NUMARC 87-00, Appendix D, and resolving Generic Safety Issue B-56. The applicant will implement final industry guidance. This is considered acceptable considering that Prairie Island's present operating procedures and practices have successfully maintained the existing diesel generators within Appendix D's reliability targets.

The applicant will perform preoperational and startup tests of the diesel engine auxiliary support systems in accordance with recommendations and guidelines of RG 1.68, "Initial Test Programs for Water Cooled Reactor Power Plants."

2.1.1 Diesel Engine Fuel Oil Storage and Transfer System

The diesel fuel oil storage and transfer system provides long term storage of fuel for the new Unit 2 diesel generators. The system consists of four safety related fuel oil storage tanks and one non-safety related receiving tank. It also includes transfer pumps, piping, instrumentation, and controls, which are necessary for supplying fuel to the diesel engines via fuel oil day tanks for seven days of continuous 100 percent operation at full rated load without being replenished. The four storage tanks will be contained in an underground concrete vault structure.

The scope of the review of the diesel engine fuel oil storage and transfer system included layout drawings, piping and instrumentation diagrams, and descriptive information provided in Reference 1 for the system and auxiliary support systems essential to its operation.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5 and 17, 10 CFR 50.63, the guidance of the cited Regulatory Guides in Section 9.5.4 of the SRP, and industry codes and standards. The review includes all piping up to the connection to the diesel engine interface, the fuel oil storage tanks, the fuel oil transfer pumps, day tanks, and tank storage vaults. In addition, the review includes the quality and quantity of fuel oil stored onsite, and the availability and procurement of additional fuel from offsite sources.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Each diesel generator is provided with a physically separate and independent oil storage and transfer system. Each system consists of two onsite storage tanks and a day tank. The entire system shares a receiving tank with the capacity of 15,000 gallons which is equivalent to two regular fuel oil shipments of 7,500 gallons each. The capacity of each onsite storage tank is 30,800 gallons. Each set of two fuel storage tanks provides sufficient capacity for 7 days usage at maximum rate. The tanks were sized according to the "conservative" calculation method suggested in ANSI N195-1976, Section 5.4. The capacity of the day tank is 600 gallons, which is sufficient to support the operation of the diesel generator for 90 minutes. The fuel storage tanks are provided with high and low level alarms which are annunciated in the diesel generator control rooms. Level switches are provided, for each day tank, to automatically refill the tank by actuating the oil transfer pumps on low tank level. No protective trip interlocks are associated with the system.

Review of the piping and system interconnections indicates that single active failures can not cause functional failure of the system. According to the applicant, sufficient space for inspection, cleaning, maintenance, and repair is provided around the components according to manufacturer's recommendations.

Descriptive information and drawings indicate that storage tanks are equipped with outside fill and vent lines. Fill inlet and vent outlet connections are located higher than the maximum flood level.

The physical location of the day tank is inside of the new diesel generator building. The tank provides a positive suction head to the booster pumps. The day tank is provided with a drain and overflow line in order to return the excess fuel oil back to the fuel oil storage tank.

Fuel oil is injected to the diesel engine cylinders in a double wall injection piping. Leakage from the inner wall is contained within the outer wall where it drains into a manifold and a leakage tank. The leakage tank is monitored by a high level alarm which indicates excessive leakage. Discharge from the leakage tank flows by gravity to a common dirty oil tank.

Drain lines provided at the bottom of all system tanks may be used to remove any accumulated water. However, water is mainly removed at each fuel storage tank, which contains a bell-shaped appendage at the bottom of the tank. The appendage will be used for periodic checking of possible water contamination.

Delivery trucks are the means of transporting and recharging the fuel to the storage tanks. The applicant has included names of three different local suppliers of oil that are capable of delivering fuel oil within 48 hours which, in emergency situations, can be reduced to 24 hours. Each oil shipment is tested in the receiving tank for verification of its quality. After verifying the conformance, fuel oil is transferred to the storage tanks where it is subject to periodic testing for water content, sediment, and viscosity. To inhibit the growth of algae in the storage tank, the fuel is furnished with an additive. Provisions have been made to minimize the creation of turbulence of the sediments at the bottom of the fuel storage tank.

Drain connections, provided for all system tanks, may used to remove sediment or water from the bottom of the tanks.

The diesel fuel oil storage and transfer system conforms with the guidance of RG 1.9, SRP Section 9.5.4, IEEE 387, and ANSI Standard N195-1976 as they relate to the design of the system, and RG 1.137 as relates to the design and fuel oil quality tests. The design therefore, meets the requirements of GDC 17 as it relates to the capability of the system to meet independence and redundancy criteria.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) scope of review, it is concluded that the design of the system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, the guidance provided in SRP Section 9.5.4, industry codes and standards; it is therefore, acceptable.

2.1.2 Diesel Engine Cooling Water System

The diesel engine cooling water system provides cooling water to the diesel engines in order to maintain the temperature within a safe operating range under all load conditions and to reduce thermal stress and wear during fast starts of the diesel engine by preheating. Each diesel engine is provided with two independent closed loop cooling systems consisting of a high temperature (HT) circuit and a low temperature circuit (LT). The HT circuit cools the engine jacket, cylinder block, and the turbocharger. The LT circuit cools the aftercooler and the lube oil heat exchanger. Both HT and LT circuits are provided with an engine-driven circulating pump, expansion tank, water-to-air heat exchanger, and a three-way thermostatic valve. In addition, the HT circuit is provided with a preheating circuit to reduce thermal stress and wear during fast starts of the diesel engine. The preheating circuit consists of an AC motor-driven standby circulating pump, an electric water heater, and a lube oil standby heat exchanger. In the standby mode when the engine is not running, the standby motor-driven circulating pump will be running to circulate water through the engine jacket. During normal engine operation, the coolant temperature for either HT or LT circuit is maintained at design temperature by the three-way thermostatic valve action to either direct flow to or bypass the radiator.

The review includes those portions of the system that receive heat from components essential for proper operation of the diesel engine and those additional parts of the system that transfer the heat to the heat sink. The system under review includes all valves, heat exchangers, pumps, and piping up to the diesel engine interface. The review of the system included layouts drawings, processing flow diagrams, piping and instrumentation diagrams, and descriptive information contained in Reference 1.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5, 17, 44, 45, and 46 and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.5.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of General Design Criteria 2, 4. and 5 is discussed in Section 2.1.

The cooling system does not depend on plant service water for its operation. Each diesel engine cooling system (HT or LT) is a closed loop system with a water-to-air heat exchanger (radiator) as the heat sink. The system's heat transfer capability under normal and transient conditions is within the scope of the diesel engine's manufacturer. The radiator, expansion tank, reservoir/storage tank and three-way valve for each loop are designed and fabricated by SACM. Each diesel engine has a physically separate independent cooling water system. All non-safety related portions of the system can be properly isolated. The cooling system is provided with high quality makeup water from the existing plant demineralized water system. This prevents the formation of scale and maintains uniform heat transfer rate in the diesel engine jackets. The cooling water is also treated with ethylene glycol for antifreeze purposes and an antirust agent.

The safety related portions of both the HT and LT cooling circuits include the radiator, the expansion tank, and interconnecting piping. The non-safety related portions include the reservoir/storage tank and piping, the AC motor-operated transfer pump and the expansion tank fill, overflow, and vent lines beyond the first isolation and drain lines valve.

Protective trip interlocks are provided for jacket water high-high temperature and jacket water low pressure, to automatically shutdown the diesel engine and protect the diesel generator units from damage during routine testing. The trips are bypassed in response to a safety injection signal. They are not bypassed upon a receipt of an automatic bus undervoltage start signal. The protective trip design complies with the guidance of RG 1.9, Position C.7.

The diesel engine cooling water system has provisions to permit periodic inspection and functional testing during standby and normal modes of power plant operation as required by GDC 45 and 46.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine cooling water system meets the requirements of GDC 2, 4, 5, 17, 44, 45, and 46, the guidance of SRP Section 9.5.5, industry codes and standards; it is therefore, acceptable.

2.1.3 Diesel Engine Starting System

The design function of the diesel engine starting system is to provide a reliable method for automatically starting each diesel generator so that the rated frequency and voltage are achieved and the unit is ready to accept required loads within 10 seconds. It consists of four independent subsystems, each including its own air dryer, compressor, and air receiver. Each starting air receiver is provided with a pressure switch which provides a low air pressure condition alarm at the control room. The air dryer is of the heatless type containing two towers that are connected in parallel. Both towers are filled with molecular sieve desiccant product. The dryer can provide dried starting air at a dew point of -4°F when the system is pressurized. No protective trip interlocks are associated with the system.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5, and 17, and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.6.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Each diesel generator has an independent and redundant air starting system consisting of two separate full-capacity air starting subsystems. Each of the four air receivers is sized to provide ten starts of the diesel engine without recharging.

An alarm system is provided for each starting air receiver including a pressure switch, which will alarm a low air pressure condition at the diesel generator control room annunciator panel, and a common trouble alarm in the main control room. The air receiver can also be controlled by means of a pressure indicator which is located on the diesel generator benchboard in the control room.

Design provisions are included to prevent fouling of the air start valve or filter by moisture, oil or rust. Design provisions are also included to blow down any accumulated moisture in the water separator provided with the compressor unit and the oil/water separators provided with the air dryer.

On the basis of the above paragraphs, the diesel engine air starting system design meets the specific guidance provided in SRP Section 9.5.6 to demonstrate compliance with the requirements of GDC 17 as it relates to independence and redundancy.

The air starting system is a high energy system. The licensee evaluated the high energy pipelines of the system against SRP Sections 3.6.1 and 3.6.2, and Branch Technical Position MEB 3-1. The licensee concluded that, since the system piping runs of the new diesel generator building are less than one inch in diameter there is no need to consider high energy pipe break loads in the design. This conclusion was considered acceptable.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine air start system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, the guidance provided in SRP Section 9.5.6, industry codes and standards; it is therefore, acceptable.

2.1.4 Diesel Engine Lubrication System

The diesel engine lubrication system provides essential lubrication to the various moving components of the diesel engine such as pistons and bearings. It consists of two cross-tied loops, pressurized by two 50% capacity engine-driven pumps. The pumps discharge supply oil from the crankcase sump through the lube oil cooler, a duplex type filter for cleaning, and distribute lube oil to the engine block. A three-way thermostatic valve regulates flow through the oil cooler. A pre-lube system is provided to maintain flow of oil during the standby mode and to maintain the lube oil above a "keep warm" temperature range through a standby heat exchanger, heated by the keepwarm portion of the high temperature cooling water system. An AC motor-driven pump is used normally for pre-lube system operation with a DC motor-driven pump for backup. Both pumps are located in the "auxiliaries desk", which is a control panel next to each diesel engine, also containing oil pressure and temperature indicators and switches.

A sufficient quantity of lube oil to permit seven days of continuous operation at rated load will be maintained on site for each diesel generator. The lube oil is stored in a lube oil tank. The lube oil storage tank provided for each diesel generator is located at an elevation to permit filling of each engine crankcase by means of gravity flow, which is controlled by a manually-operated fill valve.

The purpose of the review of the system is to assure conformance with GDC 2, 4, 5, and 17, and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.6.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Each diesel engine is provided with a dedicated lube oil system, which provides lubrication to the diesel engine wearing parts during standby conditions and/or normal and emergency starts. The diesel lube oil system (except for interconnecting piping between the engine and auxiliaries desk, which is also redundant) is an integral part of each independent and redundant diesel engine. Thus it meets the requirements of GDC 17 with regard to system independence, and single failure criteria.

Design values for operating pressure, temperature differentials, flow rate and heat removal rates are determined by the diesel engine manufacturer. Interconnecting piping between the engine and the auxiliaries desk is designed to ensure that the pressure losses within the piping meet the manufacturer's allowable pressure loss requirements.

Crankcase explosion protection, and mitigation of the consequences of such an event, is provided by a relief valve and discharge piping to the building sump.

The system is equipped with means to indicate and monitor oil level, temperature, and pressures. The system piping and instrumentation diagrams indicate the provision of temperature, pressure and level sensors, which alert the operator when these parameters exceed the range recommended by the engine manufarturer.

The temperature of the lubricating oil is automatically maintained above a minimum value by means of an independent recirculation loop including its own pump and heater. This enhances the "first-try" starting reliability of the engine in the standby condition.

On the basis of the above paragraphs, it is concluded that the design of the system meets the requirements of GDC 17 as they relate to system independence and single failure criteria.

Protective trip interlocks are provided to automatically shutdown the diesel engine, to protect the diesel generator units from damage or degradation during routine testing. The protective trips associated with the system include: 1) diesel engine lube oil low-low pressure, 2) crankcase high pressure, 3) lube oil sump low level, 4) generator bearing high temperature and, 5) engine bearing high-high lube oil temperature. These protective trips are bypassed in response to a safety injection signal, but are not bypassed upon a receipt of an automatic bus undervoltage signal. The protective trip design complies with the guidance of RG 1.9, Position C.7.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine lubrication system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, guidance provided in SRP Section 9.5.6, industry codes and standards; it is therefore, acceptable.

2.1.5 Diesel Engine Combustion Air Intake and Exhaust System

The diesel engine combustion air intake and exhaust system supplies filtered air to the diesel engine and disposes the engine exhaust to the atmosphere. The system includes an air intake filter, interconnecting piping to the engine turbocharger, exhaust piping from the turbocharger to an exhaust silencer and atmospheric discharge. The intake filter and exhaust silencer are provided by the diesel engine manufacturer. No protective trip interlocks are associated with the system.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5, and 17, and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.6.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Each diesel engine is provided with an independent combustion air intake and exhaust system. The system is arranged so that the consequence of a single failure in the air intake or exhaust system will not lead to the loss of function of more than one diesel generator. The system is sized and physically arranged so that the combined total maximum pressure drop will be within the manufacturer's recommendation. Each of the engine's dual air intake and exhaust legs are closely balanced to minimize differential back pressure. The location of the air intake relative to the exhaust precludes the intake of exhaust gases that would effect diesel generator operation.

Based on the above and the review of the layout and piping and instrumentation drawings, it is concluded that the system meets the requirements of GDC 17 with regard to system independence, redundancy, and single failure criteria.

The exhaust piping is protected from possible clogging due to rain, snow, or ice, during standby or normal operation of the system. A shield structure protects the exhaust from damage by external missiles.

The air intake system is located no less than 20 feet above grade, and is designed to prevent entrained water from entering the engine air intake.

All lube and exhaust components conform to the acceptable diesel engine manufacturer's standards discussed in Section 1.1.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine intake and exhaust system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, the guidance cited in SRP, Section 9.5.8, industry codes and standards and is; therefore, acceptable.

2.2 Diesel Generator Room Ventilation System

The diesel generator room ventilation system provides a suitable and controlled environment for engineered safety features components following certain anticipated transient and design basis accidents. The system includes all components and ducting associated with the system, from air intake to the point of discharge to the atmosphere.

The purpose of the review is to assure conformance of the design with GDC 2, 4, 5, 17, 60, 10 CFR 50.63 and industry codes and standards, in accordance with SRP Section 9.4.5. The review includes components such as air intakes, ducts, air conditioning units, flow control devices, isolation dampers, exhaust vents and exhaust fans.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition, as discussed in the introduction of this report. Meeting the requirements of GDC 2 and 4 is discussed in Section 2.1.

Each of the two diesel generator rooms has an independent ventilation system, which functions to limit the maximum ambient temperature to 120°F, in conformance with equipment ratings, when the diesel generators are operating. A diesel generator room cooling fan forces outside air into the room. Each cooling fan automatically starts operating when the corresponding diesel generator starts. The system is provided with instruments and controls to maintain the diesel generator room area temperature within design limits. Each of the two diesel generator rooms also has an independent ventilation exhaust system, which functions to provide a minimum continuous ventilation when the diesel generator set is not operating.

The system is housed in a Seismic Category I, flood and tornado protected building. The building ventilation intakes and exhausts are missile protected. The intake and exhaust openings for the emergency ventilation system are located at an elevation higher than the maximum probable flood level.

All safety related electrical equipment for the diesel generator building ventilation system is powered from engineered safety features buses.

The diesel generator building for each unit at the plant is separate, and no system supporting diesel generator room ventilation is shared by the two plant units; thus the requirements of GDC 5 are not applicable. Further, the building is not a source of radioactivity; thus, the requirements of GDC

60 and the guidelines of Regulatory Guides 1.52 and 1.140 are not applicable.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the emergency diesel generator room ventilation system meets the requirements of GDC 2, 4, 5 and 17, 10 CFR 50.63, the guidance cited in SRP Section 9.4.5, industry codes and standards; it is therefore, acceptable.

2.3 Fire Protection for Diesel Generator Area

The review covers the licensee's fire protection program for conformance with NRC guidance provided in Branch Technical Position CMEB 9.5-1. The review includes an evaluation of the automatic and manual fire suppression systems, the fire detection systems, fire barriers, and other fire protection features. The review focused on the Diesel Generator Area of the D5/D6 building.

2.3.1 General Plant Guidelines

a. <u>Building Design</u>

The licensee stated that the walls, floors and ceilings which separate the diesel generators, the fuel oil day tank and the lube oil storage tank are 3-hour-fire-rated assemblies. As a result, redundant trains of safety-related systems are separated from each other so both are not subject to damage from a single fire. All door openings in the fire barriers are rated at 3-hours.

Conduit, cable tray and piping penetrations through fire barriers within the D5/D6 Building will be sealed with penetration seals having a 3-hour-fire-rating, tested in accordance with ASTM E-119. Fire dampers in the ventilation ducts are also rated at 3-hours.

A stairway serving as access and escape route is provided for the D5/D6 building. The stairway is enclosed in 2-hour non-combustible walls.

b. Lighting and Communication

Normal lighting will provide general and local illumination for operating and maintenance activities. Emergency lighting will provide protection of personnel and allow continued safe plant operation in the event of normal lighting failure. A fixed self-contained lighting system consisting of sealed beam units with minimum 8-hour battery power are provided in accordance with 10 CFR 50, Appendix R, Section III.J.

All electrical cables and circuits for lighting, communication, fire detection and security systems are either routed in totally enclosed raceway or are IEEE 383 qualified.

c. Ventilation

The building HVAC will provide sufficient heating and ventilation air flows to maintain equipment within operating and qualification limits. No connection exists between the HVAC system and the fire sprinkler systems. In the event of a fire, operator action is required to shut-down the HVAC system. However, during operation all exhaust air will vent to the outside, therefore smoke and hot gases from a fire will not be provided to the diesel generators. Additional information on diesel generator room ventilation system is found in Section 2.2 of this report. Section 2.1.5 contains information on the handling of combustion air. Information on the diesel engine cooling water system is found in Section 2.1.2.

d. Fuel Oil Storage and Transfer System

The fuel oil storage and transfer system will provide long term storage of fuel for the diesel generator. The fuel oil storage system consists of four fuel oil storage tanks, and one receiving tank; it includes transfer pumps, piping, instrumentation and control necessary for supplying fuel to the diesel engines via fuel oil day tanks. The four storage tanks will be contained in an underground concrete vault structure which provides a 3-hour fire protection barrier between tanks for each diesel generator set. The day tanks are housed separately in rooms constructed of reinforced concrete with 3-hour fire rated walls, floors and ceilings. The licensee has stated that the fuel

TECHNICAL EVALUATION REPORT

STANDARD REVIEW PLAN COMPLIANCE EVALUATION FOR
NEW EMERGENCY DIESEL GENERATORS AT
PRAIRIE ISLAND NUCLEAR GENERATING PLANT

1.0 INTRODUCTION

This Technical Evaluation Report (TER) documents the results of a review performed by Science Applications International Corporation (SAIC) on behalf of the NRC Plant Systems Branch (SPLB) of the Design Report for the Station Blackout Electrical Safeguards Upgrade Project, Revision 1, (References 1 and 2), submitted to the NRC by the Northern States Company, Prairie Island Generating Plant.

The primary objective of the Station Blackout/Electrical Safeguards Upgrade (SBO/ESU) program at Prairie Island is to implement plant modifications necessary to comply with the final NRC rule on Station Blackout (10 CFR 50.63). This will be accomplished by the addition of two new emergency diesel generators. The new generators will serve as a dedicated source of emergency power for Unit 2 and as an alternate AC power source for Unit 1. The two existing diesel generators will serve as dedicated emergency AC power for Unit 1 and as an alternate AC power source for Unit 2. The new diesel generators, the associated panels, auxiliary equipment, electrical distribution equipment, fuel oil day tanks and lube oil tanks, will be housed in a new building to be constructed for this purpose.

The purpose of this review is to assess the compliance of the design, construction and installation of the diesel generators' auxiliary systems with the regulatory requirements of 10 CFR 50 reflected in the review process and acceptance criteria included in NUREG-0800 (Reference 3), Standard Review Plan (SRP), Sections 9.5.4 through 9.5.8. These auxiliary systems, for which SPLB has primary review responsibility, include:

(1) The diesel engine fuel oil storage and transfer system,

(2) The diesel engine cooling water system,

(3) The diesel engine starting system,

(4) The diesel engine lubrication system, and

(5) The diesel engine combustion air intake and exhaust system.

The evaluation also includes the emergency ventilation system of the new generator building, which houses the new diesel engines and the associated auxiliary systems.

In addition, the adequacy of the fire protection in the diesel generator area was evaluated against the recommendations and guidelines of Branch Technical Position (BTP) CMEB 9.5.1, "Guidelines for Fire Protection for Nuclear Power Plants" (Reference 7).

2.0 EVALUATION

2.1 Diesel Engine Auxiliary Support Systems

All components of the diesel engine auxiliary systems, that are required to operate during a design basis accident are designated as Seismic Category I and are designed and constructed to withstand a safe shutdown earthquake (SSE). The diesel engine and its engine-mounted and separately skid-mounted portions of the auxiliary support systems piping and components, normally furnished with the diesel generator package, are designed to Seismic Category I requirements. The qualification of the emergency diesel generator package supplier, SACM of France, has been the result of an extensive effort documented in "SACM Diesel Generator Qualification Report, Revision 0", submitted to the NRC as an attachment to a September 29, 1989, letter entitled "Project for the Addition of Two Emergency Diesel Generators" (Reference 6). This qualification was found acceptable by an NRC letter dated January 31, 1990.

The diesel generators and their auxiliary support systems, including the diesel fuel oil storage tanks, will be housed in the new seismic Category I diesel generator building, and the attached underground fuel oil storage vaults that provide protection from the effects of tornado, tornado missiles and floods. It has been verified that these structures are located outside of the turbine missile trajectories defined in the Prairie Island UFSAR, thus, the auxiliary systems are not subject to turbine missiles. The diesel generators are each surrounded by reinforced concrete barriers 12 to 20 inches thick. The redundant trains, of the auxiliary support systems, are separated by these barriers.

The only system in the building which includes high energy lines is the diesel generator air start system. The applicant evaluated the system against the guidance of NUREG-0800, SRP Sections 3.6.1 and 3.6.2., and BTP MEB 3-1, according to which breaks need not be postulated in piping runs of nominal piping size less than one inch. The air start piping runs for the new diesel generators are less than one inch in diameter and therefore high energy pipe breaks need not to be considered in the design.

Based on the above, the design meets the recommendation and guidance of Regulatory Guides (RG) 1.115 and 1.117, as they relate to the protection of structures, systems, and components important to safety from the effects of turbine and tornado missiles. Therefore, the design meets the requirements of General Design Criteria (GDC) 2 and 4.

The diesel generator building for each unit, at the Prairie Island Nuclear Generating Plant, is separate. Also, there are no support systems to the auxiliary systems for the new diesel generators which are shared by the two plant units. Therefore, the requirements of GDC 5 are not applicable.

Northern States Power Company has established, and is implementing an Operational Quality Assurance (QA) Plan to govern operation and modification activities of the Prairie Island Nuclear Plant. The Operational QA Plan describes, in general terms, compliance with 10 CFR 50, Appendix B, and has been reviewed and found to be acceptable by the NRC QA Branch. Design and selected safety related and non-safety related procurement activities for the project will be performed by Fluor Daniel Inc., using its QA program, which was evaluated against 10 CFR 50, Appendix B by Northern States Power. The balance of procurement activities will be performed by Northern States Power Company under the plant QA procedures. The diesel generator supplier is required, by contract, to apply a QA program meeting the requirements of 10 CFR Part 50, Appendix B.

Prairie Island has not committed to comply with NUREG/CR-0660 regarding reliability and maintenance of the diesel generators. However, the applicant is monitoring industry progress with regard to guidance for implementing NUMARC 87-00, Appendix D, and resolving Generic Safety Issue B-56. The applicant will implement final industry guidance. This is considered acceptable considering that Prairie Island's present operating procedures and practices have successfully maintained the existing diesel generators within Appendix D's reliability targets.

The applicant will perform preoperational and startup tests of the diesel engine auxiliary support systems in accordance with recommendations and guidelines of RG 1.68, "Initial Test Programs for Water Cooled Reactor Power Plants."

2.1.1 Diesel Engine Fuel Oil Storage and Transfer System

The diesel fuel oil storage and transfer system provides long term storage of fuel for the new Unit 2 diesel generators. The system consists of four safety related fuel oil storage tanks and one non-safety related receiving tank. It also includes transfer pumps, piping, instrumentation, and controls, which are necessary for supplying fuel to the diesel engines via fuel oil day tanks for seven days of continuous 100 percent operation at full rated load without being replenished. The four storage tanks will be contained in an underground concrete vault structure.

The scope of the review of the diesel engine fuel oil storage and transfer system included layout drawings, piping and instrumentation diagrams, and descriptive information provided in Reference 1 for the system and auxiliary support systems essential to its operation.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5 and 17, 10 CFR 50.63, the guidance of the cited Regulatory Guides in Section 9.5.4 of the SRP, and industry codes and standards. The review includes all piping up to the connection to the diesel engine interface, the fuel oil storage tanks, the fuel oil transfer pumps, day tanks, and tank storage vaults. In addition, the review includes the quality and quantity of fuel oil stored onsite, and the availability and procurement of additional fuel from offsite sources.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Each diesel generator is provided with a physically separate and independent oil storage and transfer system. Each system consists of two onsite storage tanks and a day tank. The entire system shares a receiving tank with the capacity of 15,000 gallons which is equivalent to two regular fuel oil shipments of 7,500 gallons each. The capacity of each onsite storage tank is 30,800 gallons. Each set of two fuel storage tanks provides sufficient capacity for 7 days usage at maximum rate. The tanks were sized according to the "conservative" calculation method suggested in ANSI N195-1976, Section 5.4. The capacity of the day tank is 600 gallons, which is sufficient to support the operation of the diesel generator for 90 minutes. The fuel storage tanks are provided with high and low level alarms which are annunciated in the diesel generator control rooms. Level switches are provided, for each day tank, to automatically refill the tank by actuating the oil transfer pumps on low tank level. No protective trip interlocks are associated with the system.

Review of the piping and system interconnections indicates that single active failures can not cause functional failure of the system. According to the applicant, sufficient space for inspection, cleaning, maintenance, and repair is provided around the components according to manufacturer's recommendations.

Descriptive information and drawings indicate that storage tanks are equipped with outside fill and vent lines. Fill inlet and vent outlet connections are located higher than the maximum flood level.

The physical location of the day tank is inside of the new diesel generator building. The tank provides a positive suction head to the booster pumps. The day tank is provided with a drain and overflow line in order to return the excess fuel oil back to the fuel oil storage tank.

Fuel oil is injected to the diesel engine cylinders in a double wall injection piping. Leakage from the inner wall is contained within the outer wall where it drains into a manifold and a leakage tank. The leakage tank is monitored by a high level alarm which indicates excessive leakage. Discharge from the leakage tank flows by gravity to a common dirty oil tank.

Drain lines provided at the bottom of all system tanks may be used to remove any accumulated water. However, water is mainly removed at each fuel storage tank, which contains a bell-shaped appendage at the bottom of the tank. The appendage will be used for periodic checking of possible water contamination.

Delivery trucks are the means of transporting and recharging the fuel to the storage tanks. The applicant has included names of three different local suppliers of oil that are capable of delivering fuel oil within 48 hours which, in emergency situations, can be reduced to 24 hours. Each oil shipment is tested in the receiving tank for verification of its quality. After verifying the conformance, fuel oil is transferred to the storage tanks where it is subject to periodic testing for water content, sediment, and viscosity. To inhibit the growth of algae in the storage tank, the fuel is furnished with an additive. Provisions have been made to minimize the creation of turbulence of the sediments at the bottom of the fuel storage tank.

Drain connections, provided for all system tanks, may used to remove sediment or water from the bottom of the tanks.

The diesel fuel oil storage and transfer system conforms with the guidance of RG 1.9, SRP Section 9.5.4, IEEE 387, and ANSI Standard N195-1976 as they relate to the design of the system, and RG 1.137 as relates to the design and fuel oil quality tests. The design therefore, meets the requirements of GDC 17 as it relates to the capability of the system to meet independence and redundancy criteria.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) scope of review, it is concluded that the design of the system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, the guidance provided in SRP Section 9.5.4, industry codes and standards; it is therefore, acceptable.

2.1.2 Diesel Engine Cooling Water System

The diesel engine cooling water system provides cooling water to the diesel engines in order to maintain the temperature within a safe operating range under all load conditions and to reduce thermal stress and wear during fast starts of the diesel engine by preheating. Each diesel engine is provided with two independent closed loop cooling systems consisting of a high temperature (HT) circuit and a low temperature circuit (LT). The HT circuit cools the engine jacket, cylinder block, and the turbocharger. The LT circuit cools the aftercooler and the lube oil heat exchanger. Both HT and LT circuits are provided with an engine-driven circulating pump, expansion tank, water-to-air heat exchanger, and a three-way thermostatic valve. In addition, the HT circuit is provided with a preheating circuit to reduce thermal stress and wear during fast starts of the diesel engine. The preheating circuit consists of an AC motor-driven standby circulating pump, an electric water heater, and a lube oil standby heat exchanger. In the standby mode when the engine is not running, the standby motor-driven circulating pump will be running to circulate water through the engine jacket. During normal engine operation, the coolant temperature for either HT or LT circuit is maintained at design temperature by the three-way thermostatic valve action to either direct flow to or bypass the radiator.

The review includes those portions of the system that receive heat from components essential for proper operation of the diesel engine and those additional parts of the system that transfer the heat to the heat sink. The system under review includes all valves, heat exchangers, pumps, and piping up to the diesel engine interface. The review of the system included layouts drawings, processing flow diagrams, piping and instrumentation diagrams, and descriptive information contained in Reference 1.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5, 17, 44, 45, and 46 and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.5.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of General Design Criteria 2, 4, and 5 is discussed in Section 2.1.

The cooling system does not depend on plant service water for its operation. Each diesel engine cooling system (HT or LT) is a closed loop system with a water-to-air heat exchanger (radiator) as the heat sink. The system's heat transfer capability under normal and transient conditions is within the scope of the diesel engine's manufacturer. The radiator, expansion tank, reservoir/storage tank and three-way valve for each loop are designed and fabricated by SACM. Each diesel engine has a physically separate independent cooling water system. All non-safety related portions of the system can be properly isolated. The cooling system is provided with high quality makeup water from the existing plant demineralized water system. This prevents the formation of scale and maintains uniform heat transfer rate in the diesel engine jackets. The cooling water is also treated with ethylene glycol for antifreeze purposes and an antirust agent.

The safety related portions of both the HT and LT cooling circuits include the radiator, the expansion tank, and interconnecting piping. The non-safety related portions include the reservoir/storage tank and piping, the AC motor-operated transfer pump and the expansion tank fill, overflow, and vent lines beyond the first isolation and drain lines valve.

Protective trip interlocks are provided for jacket water high-high temperature and jacket water low pressure, to automatically shutdown the diesel engine and protect the diesel generator units from damage during routine testing. The trips are bypassed in response to a safety injection signal. They are not bypassed upon a receipt of an automatic bus undervoltage start signal. The protective trip design complies with the guidance of RG 1.9, Position C.7.

The diesel engine cooling water system has provisions to permit periodic inspection and functional testing during standby and normal modes of power plant operation as required by GDC 45 and 46.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine cooling water system meets the requirements of GDC 2, 4, 5, 17, 44, 45, and 46, the guidance of SRP Section 9.5.5, industry codes and standards; it is therefore, acceptable.

2.1.3 Diesel Engine Starting System

The design function of the diesel engine starting system is to provide a reliable method for automatically starting each diesel generator so that the rated frequency and voltage are achieved and the unit is ready to accept required loads within 10 seconds. It consists of four independent subsystems, each including its own air dryer, compressor, and air receiver. Each starting air receiver is provided with a pressure switch which provides a low air pressure condition alarm at the control room. The air dryer is of the heatless type containing two towers that are connected in parallel. Both towers are filled with molecular sieve desiccant product. The dryer can provide dried starting air at a dew point of -4°F when the system is pressurized. No protective trip interlocks are associated with the system.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5, and 17, and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.6.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Each diesel generator has an independent and redundant air starting system consisting of two separate full-capacity air starting subsystems. Each of the four air receivers is sized to provide ten starts of the diesel engine without recharging.

An alarm system is provided for each starting air receiver including a pressure switch, which will alarm a low air pressure condition at the diesel generator control room annunciator panel, and a common trouble alarm in the main control room. The air receiver can also be controlled by means of a pressure indicator which is located on the diesel generator benchboard in the control room.

Design provisions are included to prevent fouling of the air start valve or filter by moisture, oil or rust. Design provisions are also included to blow down any accumulated moisture in the water separator provided with the compressor unit and the oil/water separators provided with the air dryer.

On the basis of the above paragraphs, the diesel engine air starting system design meets the specific guidance provided in SRP Section 9.5.6 to demonstrate compliance with the requirements of GDC 17 as it relates to independence and redundancy.

The air starting system is a high energy system. The licensee evaluated the high energy pipelines of the system against SRP Sections 3.6.1 and 3.6.2, and Branch Technical Position MEB 3-1. The licensee concluded that, since the system piping runs of the new diesel generator building are less than one inch in diameter there is no need to consider high energy pipe break loads in the design. This conclusion was considered acceptable.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine air start system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, the guidance provided in SRP Section 9.5.6, industry codes and standards; it is therefore, acceptable.

2.1.4 Diesel Engine Lubrication System

The diesel engine lubrication system provides essential lubrication to the various moving components of the diesel engine such as pistons and bearings. It consists of two cross-tied loops, pressurized by two 50% capacity engine-driven pumps. The pumps discharge supply oil from the crankcase sump through the lube oil cooler, a duplex type filter for cleaning, and distribute lube oil to the engine block. A three-way thermostatic valve regulates flow through the oil cooler. A pre-lube system is provided to maintain flow of oil during the standby mode and to maintain the lube oil above a "keep warm" temperature range through a standby heat exchanger, heated by the keepwarm portion of the high temperature cooling water system. An AC motor-driven pump is used normally for pre-lube system operation with a DC motor-driven pump for backup. Both pumps are located in the "auxiliaries desk", which is a control panel next to each diesel engine, also containing oil pressure and temperature indicators and switches.

A sufficient quantity of lube oil to permit seven days of continuous operation at rated load will be maintained on site for each diesel generator. The lube oil is stored in a lube oil tank. The lube oil storage tank provided for each diesel generator is located at an elevation to permit filling of each engine crankcase by means of gravity flow, which is controlled by a manually-operated fill valve.

The purpose of the review of the system is to assure conformance with GDC 2, 4, 5, and 17, and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.6.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Ea . diesel engine is provided with a dedicated lube oil system, which provides lubrication to the diesel engine wearing parts during dby conditions and/or normal and emergency starts. The diesel lube oil system (except for interconnecting piping between the engine and auxiliaries desk, which is also redundant) is an integral part of each independent and redundant diesel engine. Thus it meets the requirements of GDC 17 with regard to system independence, and single failure criteria.

Design values for operating pressure, temperature differentials, flow rate and heat removal rates are determined by the diesel engine manufacturer. Interconnecting piping between the engine and the auxiliaries desk is designed to ensure that the pressure losses within the piping meet the manufacturer's allowable pressure loss requirements.

Crankcase explosion protection, and mitigation of the consequences of such an event, is provided by a relief valve and discharge piping to the building sump.

The system is equipped with means to indicate and monitor oil level, temperature, and pressures. The system piping and instrumentation diagrams indicate the provision of temperature, pressure and level sensors, which alert the operator when these parameters exceed the range recommended by the engine manufacturer.

The temperature of the lubricating oil is automatically maintained above a minimum value by means of an independent recirculation loop including its own pump and heater. This enhances the "first-try" starting reliability of the engine in the standby condition.

On the basis of the above paragraphs, it is concluded that the design of the system meets the requirements of GDC 17 as they relate to system independence and single failure criteria.

Protective trip interlocks are provided to automatically shutdown the diesel engine, to protect the diesel generator units from damage or degradation during routine testing. The protective trips associated with the system include: 1) diesel engine lube oil low-low pressure, 2) crankcase high pressure, 3) lube oil sump low level, 4) generator bearing high temperature and, 5) engine bearing high-high lube oil temperature. These protective trips are bypassed in response to a safety injection signal, but are not bypassed upon a receipt of an automatic bus undervoltage signal. The protective trip design complies with the guidance of RG 1.9, Position C.7.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine lubrication system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, guidance provided in SRP Section 9.5.6, industry codes and standards; it is therefore, acceptable.

2.1.5 Diesel Engine Combustion Air Intake and Exhaust System

The diesel engine combustion air intake and exhaust system supplies filtered air to the diesel engine and disposes the engine exhaust to the atmosphere. The system includes an air intake filter, interconnecting piping to the engine turbocharger, exhaust piping from the turbocharger to an exhaust silencer and atmospheric discharge. The intake filter and exhaust silencer are provided by the diesel engine manufacturer. No protective trip interlocks are associated with the system.

The purpose of the review of the system is to assure conformance of the design with GDC 2, 4, 5, and 17 and 10 CFR 50.63, in accordance with the guidance provided in SRP Section 9.5.6.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition as discussed in the introduction of this report. Meeting the requirements of GDC 2, 4, and 5 is discussed in Section 2.1.

Each diesel engine is provided with an independent combustion air intake and exhaust system. The system is arranged so that the consequence of a single failure in the air intake or exhaust system will not lead to the loss of function of more than one diesel generator. The system is sized and physically arranged so that the combined total maximum pressure drop will be within the manufacturer's recommendation. Each o the engine's dual air intake and exhaust legs are closely balanced to minimize differential back pressure. The location of the air intake relative to the exhaust precludes the intake of exhaust gases that would effect diesel generator operation.

Based on the above and the review of the layout and piping and instrumentation drawings, it is concluded that the system meets the requirements of GDC 17 with regard to system independence, redundancy, and single failure criteria.

The exhaust piping is protected from possible clogging due to rain, snow, or ice, during standby or normal operation of the system. A shield structure protects the exhaust from damage by external missiles.

The air intake system is located no less than 20 feet above grade, and is designed to prevent entrained water from entering the engine air intake.

All lube and exhaust components conform to the acceptable diesel engine manufacturer's standards discussed in Section 1.1.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the diesel engine intake and exhaust system meets the requirements of GDC 2, 4, 5, and 17, 10 CFR 50.63, the guidance cited in SRP, Section 9.5.8, industry codes and standards and is; therefore, acceptable.

2.2 Diesel Generator Room Ventilation System

The diesel generator room ventilation system provides a suitable and controlled environment for engineered safety features components following certain anticipated transient and design basis accidents. The system includes all components and ducting associated with the system, from air intake to the point of discharge to the atmosphere.

The purpose of the review is to assure conformance of the design with GDC 2, 4, 5, 17, 60, 10 CFR 50.63 and industry codes and standards, in accordance with SRP Section 9.4.5. The review includes components such as air intakes, ducts, air conditioning units, flow control devices, isolation dampers, exhaust vents and exhaust fans.

Compliance with 10 CFR 50.63 is a primary objective of the diesel generator addition, as discussed in the introduction of this report. Meeting the requirements of GDC 2 and 4 is discussed in Section 2.1.

Each of the two diesel generator rooms has an independent ventilation system, which functions to limit the maximum ambient temperature to 120°F, in conformance with equipment ratings, when the diesel generators are operating. A diesel generator room cooling fan forces outside air into the room. Each cooling fan automatically starts operating when the corresponding diesel generator starts. The system is provided with instruments and controls to maintain the diesel generator room area temperature within design limits. Each of the two diesel generator rooms also has an independent ventilation exhaust system, which functions to provide a minimum continuous ventilation when the diesel generator set is not operating.

The system is housed in a Seismic Category I, flood and tornado protected building. The building ventilation intakes and exhausts are missile protected. The intake and exhaust openings for the emergency ventilation system are located at an elevation higher than the maximum probable flood level.

All safety related electrical equipment for the diesel generator building ventilation system is powered from engineered safety features buses.

The diesel generator building for each unit at the plant is separate, and no system supporting diesel generator room ventilation is shared by the two plant units; thus the requirements of GDC 5 are not applicable. Further, the building is not a source of radioactivity; thus, the requirements of GDC

60 and the guidelines of Regulatory Guides 1.52 and 1.140 are not applicable.

Based on the above, and within the scope of the Plant Systems Branch (SPLB) review, it is concluded that the design of the emergency diesel generator room ventilation system meets the requirements of GDC 2, 4, 5 and 17, 10 CFR 50.63, the guidance cited in SRP Section 9.4.5, industry codes and standards; it is therefore, acceptable.

2.3 Fire Protection for Diesel Generator Area

The review covers the licensee's fire protection program for conformance with NRC guidance provided in Branch Technical Position CMEB 9.5-1. The review includes an evaluation of the automatic and manual fire suppression systems, the fire detection systems, fire barriers, and other fire protection features. The review focused on the Diesel Generator Area of the D5/D6 building.

2.3.1 General Plant Guidelines

a. Building Design

The licensee stated that the walls, floors and ceilings which separate the diesel generators, the fuel oil day tank and the lube oil storage tank are 3-hour-fire-rated assemblies. As a result, redundant trains of safety-related systems are separated from each other so both are not subject to damage from a single fire. All door openings in the fire barriers are rated at 3-hours.

Conduit, cable tray and piping penetrations through fire barriers within the D5/D6 Building will be sealed with penetration seals having a 3-hour-fire-rating, tested in accordance with ASTM E-119. Fire dampers in the ventilation ducts are also rated at 3-hours.

A stairway serving as access and escape route is provided for the D5/D6 building. The stairway is enclosed in 2-hour non-combustible walls.

b. Lighting and Communication

Normal lighting will provide general and local illumination for operating and maintenance activities. Emergency lighting will provide protection of personnel and allow continued safe plant operation in the event of normal lighting failure. A fixed self-contained lighting system consisting of sealed beam units with minimum 8-hour battery power are provided in accordance with 10 CFR 50, Appendix R, Section III.J.

All electrical cables and circuits for lighting, communication, fire detection and security systems are either routed in totally enclosed raceway or are IEEE 383 qualified.

c. Ventilation

The building HVAC will provide sufficient heating and ventilation air flows to maintain equipment within operating and qualification limits. No connection exists between the HVAC system and the fire sprinkler systems. In the event of a fire, operator action is required to shut down the HVAC system. However, during operation all exhaust air will vent to the outside, therefore smoke and hot gases from a fire will not be provided to the diesel generators. Additional information on diesel generator room ventilation system is found in Section 2.2 of this report. Section 2.1.5 contains information on the handling of combustion air. Information on the diesel engine cooling water system is found in Section 2.1.2.

d. Fuel Oil Storage and Transfer System

The fuel oil storage and transfer system will provide long term storage of fuel for the diesel generator. The fuel oil storage system consists of four fuel oil storage tanks, and one receiving tank; it includes transfer pumps, piping, instrumentation and control necessary for supplying fuel to the diesel engines via fuel oil day tanks. The four storage tanks will be contained in an underground concrete vault structure which provides a 3-hour fire protection barrier between tanks for each diesel generator set. The day tanks are housed separately in rooms constructed of reinforced concrete with 3-hour fire rated walls, floors and ceilings. The licensee has stated that the fuel oil storage tanks will be horizontal cylindrical tanks made of materials compatible with the stored diesel fuel oil. The tanks will meet the requirements of NFPA 30. Section 2.1.1 of this report gives details on the fill and vent arrangement, location and leakage provisions for the fuel oil storage and day tanks.

The foregoing paragraphs provides reasonable assurance that adequate measures are being provided in accordance with the guidelines of BTP CMEB 9.5-1 and are, therefore, acceptable.

2.3.2 Fire Detection and Suppression

2.3.2.1 Fire Detection

The licensee stated that thermal and ionization smoke detection will be located in strategic points in D5/D6 Building for fire detection. The fire detection and alarm system will be zoned and installed in accordance with NFPA 72A, 72D and 72E. The system will give audible and visual alarms and annunciation in the main control room. The fire detection system will also provide audible alarms locally. The operating voltage from the panel to the fire detectors will be 24V DC. In accordance with NFPA 13, the fire alarm system will be designed so that it monitors the valves for the automatic sprinkler and the standpipe systems. This is in accordance with the BTP CMEB 9.5-1, and is therefore acceptable.

2.3.2.2 Water Sprinkler and Hose Standpipe Systems

Each Diesel Generator will be protected by an automatic preaction sprinkler system. Each system is automatically activated upon signal from a single zone heat detector. The Fuel Oil Day Tank Room and Lube Oil Room, each have automatic wet pipe sprinkler systems. A deluge system protects the Fuel Oil Receiving Tank. These features will be designed and installed in accordance with NFPA 13.

Appropriate hose stations will be installed to protect all areas at each elevation. These will be located in accordance with NFPA 14. We have reviewed the design criteria and bases for the water suppression and hose standpipe systems. We conclude that the systems meet the guidelines of BTP CMEB 9.5-1, and are, therefore, acceptable.

2.3.2.3 Portable Extinguishers

Fire extinguishers, in accordance with NFPA 10, are provided in areas that could present a fire exposure hazard to safety-related equipment. An appropriate number of fire extinguishers will be conspicuously located along the normal paths of travel, including outside the diesel generator area. The fire extinguisher plan conforms to the guidance of NFPA 10, and is therefore acceptable.

2.3.2.4 Local Manual Venting

The licensee has considered means for local manual venting of smoke during and after a fire. The licensee will provide appropriate portable fans to vent smoke from a fire location. This satisfies the guidelines of BTP CMEB 9.5-1, and is therefore acceptable.

2.3.2.5 Drainage for Fire Fighting Water

The licensee will provide means of drainage for firefighting water. Fire suppression water will flow to the basement area via open sleeves and an access hatch in the diesel generator room. No safety related equipment or instruments exist in the basement area. The discharged water will accumulate in the basement and will be removed by use of portable pumps when the fire is extinguished. This meets the requirements for firefighting water drainage in the BTP, and is therefore acceptable.

3.0 CONCLUSIONS

3.1 Auxiliary Systems

Based on the review of References 1 and 2, it is concluded that the proposed design, construction, installation, and operation of the new diesel generators' auxiliary systems and emergency ventilation system comply with the regulatory requirements of 10 CFR 50 reflected in the acceptance criteria and guidance included in NUREG-0800, SRP Sections 9.5.4 through 9.5 8 and SRP Section 9.4.5.

3.2 Fire Protection System

Based on the above evaluation, the staff concludes that the fire protection features in the Diesel Generator Area are adequate. Fire detection and suppression systems will be strategically located throughout the new structure. All safety-related systems are separated from each other and other fire areas by 3-hour rated barriers. We conclude that the licensee's provisions for fire protection meet with the guidelines of Branch Technical Position CMEB 9.5-1.

4.0 REFERENCES

1. Design Report for the Station Blackout/Electrical Safeguards Upgrade Project, Revision 1, Prairie Island Nuclear Generating Plant, December 23, 1991.

2. Parker, Thomas N., Letter to NRC Document Control Desk, Prairie Island Nuclear Generating Plant, Docket Nos. 50-282, 50-306, dated January 8, 1992.

3. U.S. Nuclear Regulatory Commission," Standard Review Plan," NUREG-0800, Revision 2, July 1981.

4. National Fire Protection Association, NFPA 10. "Standard for the Installation of Standpipe and Hose System."

5. National Fire Protection Association, NFPA 13 "Standard for Sprinkle System."

6. National Fire Protection Association, NFPA 14, "Standard for Portable Fire Extinguisher."

7. Branch Technical Position (BTP) CMEB 9.5.1 "Guidelines for Fire Protection for Nuclear Power Plant"

8. Letter to NRC "Project for the Addition of Two Emergency Diesel Generators."