

Proposed - For Interim Use and Comment



U.S. NUCLEAR REGULATORY COMMISSION **DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER™ iPWR DESIGN**

9.5.2 COMMUNICATIONS SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of instrumentation and controls

Secondary - None

I. AREAS OF REVIEW

The communications systems discussed herein are involved primarily with verbal communication functions between personnel and organizations, although there may be physical communication links also used in some cases to transmit limited data communications (i.e., web page or as facsimile (fax) transmission over the telephone lines.) Design-Specific Review Standard (DSRS) Chapter 7 and Section 13.3 address the review of systems for communicating data between portions of the instrumentation systems and between site related facilities such as the Main Control Room, Technical Support Center (TSC), Operations Support Center (OSC), Emergency Operations Facility (EOF), metrological stations, and security stations.

This review of the communications systems is limited to that portion of the system used in intraplant (including among multiple modules, units, and control rooms at a single plant site) and plant-to-offsite communications during normal operation, transients, fire, accident, off-normal phenomena including tornado, hurricane, flood, tsunami, lightning strike, and earthquake and declared emergencies, and security-related events.

The specific areas of review are as follows:

1. System Capabilities. The communications system is reviewed with respect to assuring the capability of the system and related plant design features to provide effective intraplant communications and effective plant-to-offsite communications during normal plant operations and emergencies, including loss of offsite power, and to support plant security and meet regulations.
2. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this DSRS section in accordance with DSRS Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this DSRS section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with DSRS Section 14.3 and DSRS Section 13.3.

3. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items, requirements, and restrictions (e.g., interface requirements and site parameters).

For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

Review Interfaces

Other DSRS sections interface with this section as follows:

1. Verification that the offsite communication system equipment provided will adequately support emergency plan requirements for accident conditions plus notification of the U.S. Nuclear Regulatory Commission (NRC) and site personnel and implementation of evacuation procedures is performed under DSRS Section 13.3.
2. The review of procedures and testing to determine the acceptability of the preoperational and startup tests is performed under DSRS Section 14.2.
3. Verification that onsite communications are adequate for the coordination of firefighting, including support of alternative and dedicated shutdown capabilities, is performed under Standard Review Plan (SRP) Sections 9.5.1.1 or 9.5.1.2. Regulatory Guide (RG) 1.189, Revision 2, "Fire Protection for Nuclear Power Plants," provides guidance on communication system functions needed to support firefighting activities.
4. Verification that onsite and offsite communications are adequate for coordination and support of security activities both within the plant and with external security and law enforcement organizations is performed under SRP Section 13.6.
5. Verification of the adequacy of control room communications and features to support reliable human performance is performed under SRP Chapter 18.

The specific acceptance criteria and review procedures are contained in the referenced DSRS and SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. Appendix E to Title 10 of the *Code of Federal Regulations* (CFR), Part 50, "Emergency Planning and Preparedness for Production and Utilization Facilities," particularly Part IV.E(9), as it relates to the provision of at least one onsite and one offsite communications system, each with a backup power source.
2. 10 CFR 50.34(f)(2)(xxv) (regarding Three Mile Island (TMI) Action Plan Item III A.1.2).

3. 10 CFR 50.47(b)(6) and 10 CFR 50.47(b)(8) (regarding equipment and facilities to support emergency response).
4. 10 CFR 50.55a, "Codes and Standards."
5. General Design Criteria (GDC) 1, "Quality Standards and Records."
6. GDC 2, "Design Bases for Protection Against Natural Phenomena."
7. GDC 3, "Fire Protection."
8. GDC 4, "Environmental and Dynamic Effects Design Bases."
9. GDC 19, "Control Room."
10. 10 CFR 73.45(e)(2)(iii) (regarding performance capabilities for fixed site physical protection systems - communications subsystems).
11. 10 CFR 73.45(g)(4)(i) (regarding provide communications networks).
12. 10 CFR 73.45(g)(4)(ii) (regarding provide communications networks).
13. 10 CFR 73.46(f) (regarding fixed site physical protection systems, subsystems, components, and procedures - communications subsystems).
14. 10 CFR 73.55(e)(9)(vi)(B) (regarding requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage - vital areas).
15. 10 CFR 73.55(j) (regarding requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage - communication requirements).
16. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed ITAACs that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the DC is built and will operate in accordance with the DC, the provisions of the Atomic Energy Act (AEA), and the NRC's regulations;
17. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the AEA, and the NRC's regulations.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are set forth below. The DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. Identifying the differences between this DSRS section and the design features, analytical techniques, and procedural measures proposed for the facility, and discussing how the proposed alternative provides an acceptable

method of complying with the regulations that underlie the DSRS acceptance criteria, is sufficient to meet the requirements in 10 CFR 52.47(a)(9), "Contents of applications; technical information." The same approach may be used to meet the requirements of 10 CFR 52.79(a)(41) for COL applications.

Many of the regulations are related to the emergency plan, site and plant physical protection of licensed activities against radiological sabotage, and other security activities. In these cases the technical and safety review should focus on whether the physical communications equipment provided and its capability and attributes are adequate to support the emergency plan and security needs. For example, if there is a loss of normal power, is there a reliable alternate source. The actual review of the application of the communications equipment concerning security and the emergency plan is addressed in the sections of this DSRS related to security and the emergency plan.

1. Information regarding the requirements of Appendix E to 10 CFR Part 50, Part IV.E(9), will be found acceptable if adequate provisions for communications are made and described for emergency facilities and equipment, including, but not limited to, at least one onsite and one offsite communications system; each system shall have a backup power source.
2. Information regarding the requirements of 10 CFR 50.34(f)(2)(xxv) and TMI Action Plan Item III A.1.2 will be found acceptable if adequate provisions for communications are made to support an onsite TSC, an onsite OSC, and, a nearsite EOF.
3. Information regarding the requirements of 10 CFR 50.47(b)(6) and 10 CFR 50.47(b)(8) will be found acceptable if adequate provisions for communications are provided and maintained in the emergency facilities and control room to support the emergency response, including prompt communication among principal response organizations to emergency personnel and to the public.
4. Information regarding the requirements of 10 CFR 50.55a will be found acceptable if SSCs are designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed.
5. For a DC application, information regarding the requirements of 10 CFR 52.47(b)(1) will be found acceptable if adequate ITAAC for the communications systems are described (in the application) that are necessary and sufficient to provide reasonable assurance that, if the inspections, test, and analysis are performed and the acceptance criteria met, a facility that incorporates the DC will have been constructed and will be operated in conformity with the DC, the provisions of the AEA, and the NRC's regulations.
6. For a COL application, information regarding the requirements of 10 CFR 52.80(a) will be found acceptable if adequate ITAAC for the communications systems are described that are necessary and sufficient to provide reasonable assurance that, if the inspections, test, and analysis are performed and the acceptance criteria met, a facility will have been constructed and will operate in conformity with the COL, the provisions of the AEA, and the NRC's regulations.
7. Information regarding the requirements of GDC 1 will be found acceptable if communication equipment and related support equipment important to safety are designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes

and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function.

8. Information regarding the requirements of GDC 2 will be found acceptable if communication equipment and related support equipment important to safety are designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions and other requirements specifically identified in GDC 2.
9. Information regarding the requirements of GDC 3 will be found acceptable if communication equipment and related support equipment important to safety are designed and located to minimize, consistent with other safety requirements, the probability and effect of fires, smoke effects from fires, and explosions and other requirements specifically identified in GDC 3.
10. Information regarding the requirements of GDC 4 will be found acceptable if communication equipment and related support equipment important to safety are designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents and other requirements specifically identified in GDC 4.
11. Information regarding the requirements of GDC 19 will be found acceptable if adequate communication equipment is described that is designed and provided at appropriate locations inside the control room with the capability to support all normal and emergency operations, including intraplant communications and plant to emergency facilities and offsite communication requirements even in the event of a single failure within a communication subsystem or the loss of the normal power source and other requirements specifically identified in GDC 19.
12. Information regarding the requirements of 10 CFR 73.45(e)(2)(iii), 10 CFR 73.45(g)(4)(i), and 10 CFR 73.45(g)(4)(ii) will be found acceptable if adequate provisions for communications subsystems and procedures are made and described that support site physical protection including the ability to transmit rapid and accurate security information among onsite forces for routine security operations, assessment of a contingency, response to a contingency, detection and assessment information to offsite assistance forces, and other requirements specifically identified in the regulations.
13. Information regarding the requirements of 10 CFR 73.46(f) will be found acceptable if adequate provisions for communications are made and described that support site security, including the ability for each guard, watchman, or armed response individual on duty shall be capable of maintaining continuous communication with an individual in each continuously manned alarm station required by 10 CFR 73.46(e)(5), who shall be capable of calling for assistance from other guards, watchmen, and armed response personnel and from law enforcement authorities and other requirements specifically identified in the regulation.
14. Information regarding the requirements of 10 CFR 73.55(e)(9)(vi)(B) will be found acceptable if adequate provisions for the secondary power supply systems for non-portable communications equipment is located within a vital area.

15. Information regarding the requirements of 10 CFR 73.55(j) will be found acceptable if adequate provisions for communications are made and described that support site security including the capability to establish and maintain continuous communication with onsite and offsite resources to ensure effective command and control during normal and emergency situations and other requirements specifically identified in the regulation.

III. REVIEW PROCEDURES

These review procedures are based on the above identified DSRS acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. In accordance with 10 CFR 52.47(a)(8),(21), and (22), for new reactor license applications submitted under Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues that are identified in the version of NUREG-0933 current on the date 6 months before application and that are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and, (3) provide information necessary to demonstrate compliance with any technically relevant portions of the TMI requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v). Reference: 10 CFR 52.47(a)(21), 10 CFR 52.47(a)(22), and 10 CFR 52.47(a)(8), respectively. These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding safety evaluation report (SER) section.
2. The reviewer will evaluate information provided in the final safety analysis report (FSAR) pertaining to the design of the communication system and related plant features to determine whether intraplant communication equipment needed in vital areas during recovery actions from transient, fire, or accident conditions is provided in a manner that supports proper operation of other plant equipment.
3. The staff will review the design-basis, design criteria, and system description sections and the analyses that demonstrate the effectiveness of the system when plant noise levels are at their maximum during incident and accident conditions to verify that the communication system will function effectively. Reviewers should use engineering judgment in conjunction with a comparison of the system capabilities with equipment and communication systems provided for previously approved plants. Reviewers will assess the capability of proposed communications systems to ensure adequate intraplant communication among multiple modules, units, and control rooms at a single plant site in normal operating and accident conditions.

For new applications, the review should involve the following activities:

- A. Verification that effective communication will not be impeded by transmission through barriers, high-noise areas, personnel use of protective equipment, inadequate number of communication channels, interference between channels or subsystems, or interference from other electronic or electrical equipment.
- B. Verification that coverage of wireless communications capability is adequate to support needed communications with plant and offsite personnel.

- C. Verification that the number and location of hardwired communication sets are adequate to support communications with plant and offsite personnel.
- D. Verification that the features that alert personnel in high-noise environments to use the communication systems are adequate.
- E. Verification that system equipment required to mitigate the consequences of a specific design-basis event (DBE) (e.g., natural phenomena, violent external attack) is independent of, and physically separated from, the effects of the DBE (e.g., fire suppression actuation, loss of offsite power) to the degree necessary to retain the communications capability during these events.
- F. Verification that functional testing is planned under conditions that simulate the maximum plant noise levels generated during the various operating conditions, including fire and accident conditions, to demonstrate system capabilities. Regulatory Position 4.1.6 of RG 1.189 provides direction related to communication capabilities during fires.
- G. Verification that the communications equipment, including offsite equipment, will remain operable in the event of loss of primary power and that secondary power supplies for non-portable equipment are located within vital areas. Configuration of communications equipment should include consideration of the concerns raised in NRC IE Bulletin 80-15, "Possible Loss of Emergency Notification System (ENS) with Loss of Offsite Power."
- H. Verification that communications systems and equipment have been evaluated to determine their applicability, adequacy, and sufficiency to assure a quality product in keeping with the required functions and the application from the guidance from Electric Power Research Institute (EPRI) NP-5652, "Guideline for the Utilization of Commercial-Grade Items in Nuclear Safety-Related Applications," (conditionally endorsed by Generic Letter (GL) 89-02), and the guidance of EPRI TR-106439, "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications," (accepted by an NRC safety evaluation, dated July 17, 1997 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML12205A284 and ML092190664)) should be considered if computer-based equipment or digital components requiring software or software developed logic devices are involved.
- I. Verification that communications equipment will be compatible with the electromagnetic interference (EMI) and radiofrequency interference (RFI) environments of the plant and that design measures have been taken such that there will be no interference between wireless communications systems and other plant equipment, including application of the appropriate guidance from RG 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems." While nonsafety systems are not a part of this RG, control of EMI/RFI from these systems is necessary to ensure that safety-related instrumentation and controls systems can continue to perform properly in the nuclear power plant environment. When feasible, the emissions from nonsafety-related systems should be held to the same levels as those from safety-related systems.

- J. Verification of the adequacy of any special equipment facilitating communications with personnel using protective equipment (e.g., respirators, underwater diving equipment).
- 4. The reviewer may decide that, for a specific case, specific aspects of the design should receive emphasis, while other aspects of the design need not receive the same emphasis and in-depth review. Typical reasons for such non-uniform emphasis are the introduction of new communication system designs or the use of communication systems previously found acceptable in similar circumstances. However, in all cases, the review must be sufficient to conclude conformity with the requirements of the NRC's regulations. For deviations from specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives to the DSRS criteria provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II of this document above.
- 5. For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), is set forth in the design control document (DCD). The reviewer should also consider the appropriateness of COL action items identified in the DCD. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DCD.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit or other NRC approvals (e.g., manufacturing license, site suitability report or topical report (TR)).

For review of both DC and COL applications, DSRS Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's SER. The reviewer also states the bases for those conclusions.

The communication system includes all components for intraplant and plant-to-offsite communications. The scope of review of the communications system for the plant includes verification that offsite equipment is capable of providing for notification of personnel and implementation of evacuation procedures, and verification that onsite communications are adequate in the event of an emergency.

The basis for acceptance of the communication system in the review is conformance of the design, design criteria, and design bases to the applicable regulations and industry standards as demonstrated in meeting the DSRS Acceptance Criteria identified above; and the ability of the system to provide effective communications between plant personnel in all vital areas during the full spectrum of accident or incident conditions under maximum potential noise levels.

The staff concludes that the design of the communications system meets the staff's criteria and industry standards and is therefore acceptable.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this DSRS section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this DSRS section in performing safety evaluations of mPower™-specific DC, or COL, applications submitted by applicants pursuant to 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations.

Because of the numerous design differences between the mPower™ and large light-water nuclear reactor power plants, and in accordance with the direction given by the Commission in SRM- COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010 (ADAMS Accession No. ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor reviews including the associated pre-application activities, the staff has developed the content of this DSRS section as an alternative method for mPower™ -specific DC, or COL submitted pursuant to 10 CFR Part 52 to comply with 10 CFR 52.47(a)(9), "Contents of applications; technical information."

This regulation states, in part, that the application must contain "an evaluation of the standard plant design against the SRP revision in effect 6 months before the docket date of the application." The content of this DSRS section has been accepted as an alternative method for complying with 10 CFR 52.47(a)(9) as long as the mPower™ DCD FSAR does not deviate significantly from the design assumptions made by the NRC staff while preparing this DSRS section. The application must identify and describe all differences between the standard plant design and this DSRS section, and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria. If the design assumptions in the DC application deviate significantly from the DSRS, the staff will use the SRP as specified in 10 CFR 52.47(a)(9). Alternatively, the staff may supplement the DSRS section by adding appropriate criteria in order to address new design assumptions. The same approach may be used to meet the requirements of 10 CFR 52.79(a)(41), and COL applications.

VI. REFERENCES

1. RG 1.189, Revision 2, "Fire Protection for Nuclear Power Plants," October 2009.
2. EPRI NP-5652, "Guideline for the Utilization of Commercial-Grade Items in Nuclear Safety-Related Applications," Final Report, Electric Power Research Institute, June 1988 (conditionally endorsed by GL 89-02.)
3. EPRI TR-106439, "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications," Electric Power Research Institute, October 1996

(ADAMS Accession No. ML103360462) (accepted by a NRC safety evaluation, dated July 17, 1997 (ADAMS Accession Nos. ML12205A284 and ML092190664)).

4. IE Bulletin 80-15, "Possible Loss of Emergency Notification System (ENS) with Loss of Offsite Power," June 18, 1980 (ADAMS Accession No. ML112700327).
5. RG 1.180, Revision 1, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, October 2003.
6. RG 1.215, "Guidance for ITAAC Closure under 10 CFR Part 52."
7. Safety Evaluation by the Office of Nuclear Reactor Regulation, "EPRI Topical Report TR-106439," July 17, 1997.