ATTACHMENT 65001.19

INSPECTION OF INSTALLATION
OF ITAAC-RELATED RADIATION MONITORING COMPONENTS AND SYSTEMS

PROGRAM APPLICABILITY: 2503

65001.19-01 INSPECTION OBJECTIVES

01.01 To determine whether activities relative to radiation monitoring components and systems (RMCS) are being accomplished in accordance with NRC requirements, the final safety analysis report (FSAR), design specifications and drawings, industry standards, and licensee commitments and procedures.

01.02 To evaluate the performance of ITAAC-related RMCS.

01.03 To determine whether the general records for the installation and testing of RMCS are consistent with NRC requirements, the FSAR, and licensee commitments and procedures.

01.04 To evaluate the adequacy of the implementation of the specific quality assurance (QA) program requirements for the installation and testing of RMCS, and to ensure problems are entered into the corrective action process.

65001.19-02 INSPECTION REQUIREMENTS AND GUIDANCE

This inspection procedure (IP) covers the inspection of the installation and testing of RMCS. This includes field sensors, transmitters, indication displays, instrumentation systems that process field information and actuate other components and protection systems, logic and control devices, and annunciation. It does not include cabling, except when the cabling is an integral part of the instrument component, for example, thermocouple cabling.

For the RMCS listed in this IP, periodic inspections shall be performed on a frequency commensurate with construction progress, but in general, no less frequently than semi annually.

Because RMCS are important, extensive inspection activities are to be conducted periodically. In-process construction and installation inspections should be scheduled to match appropriate installation activities. It is expected that the scope of periodic inspections will vary with construction progress, problems encountered, etc. Not all the steps of this IP are required to be performed each time it is implemented. It may be appropriate for a particular inspection to implement only certain steps in this IP. Additional inspections should be made when and where conditions warrant. Any installation activity that has been delayed or suspended for more than one year, or has been subject to significant procedural, design, or personnel change, should be re-evaluated immediately after resumption of the work or after the changes have been made. Inspectors should be aware

of how the inspection requirements and guidance in the following steps and the subsequent inspection results can provide the justification for concluding that the ITAAC, for RMCS, for a specific advanced reactor design are complete.

02.01 Pre-Inspection Activities.

a. Inspection Preparation.

1. The inspector should develop a basic understanding of the RMCS of the particular plant design (e.g., AP 1000), and how they interrelate to one another and to the main control room (MCR) readouts.

Guidance. The RMCS being referred to are those that process the signals from field detectors, and provide displays to the MCR and from there to other accessible data systems. The focus is on the purpose of each system and their sub-systems, the types of inputs and outputs to/from each system, and how these systems interrelate to other plant systems. However, since RMCS includes components, a working knowledge of the larger more distinct components would also be appropriate. A basic familiarity with non-safety related RMCS is also applicable. The goal is to become familiar with all RMCS including the actual hardware but to give more attention to those systems that have a large number of ITAAC associated with them. The inspector can use the FSAR, plant-specific design control documents (DCDs) or equivalent, and construction drawings and specifications for the requested inspection preparation.

2. The inspector should understand the nature and types of the ITAAC residing in “families” along row (19) of the ITAAC matrix for Radiation Monitoring components and systems.

Guidance. The attributes of the ITAAC for row 19 of the matrix are important because they will be the focus of the inspections for RMCS. The inspection results for the implementations of this IP will eventually be used to verify the licensee’s documentation that indicates completion of the ITAAC for RMCS.

3. Review the FSAR and licensee/contractor QA programs to determine the documentation requirements for the fabrication, installation, and testing of RMCS.

Guidance. The licensee should maintain clear, concise records during the fabrication, installation, and testing of RMCS. Where possible, the record reviews of this IP should be performed in conjunction with the inspection of work and test activities. Look for inadequacies that could lead to construction or testing deficiencies and indicate inadequate management control. Quality records should be selected for review based on their association with ITAAC, safety, and risk significance. Ascertain who is responsible for preparing, reviewing, and ensuring the accuracy of quality-related records.

4. The inspector should verify with NRO that the RMCS, actually purchased, are in accordance with the plant’s design basis.

Guidance. The majority of the RMCS were not actually defined down to the hardware level in the plant-specific DCD or equivalent. In most cases, the related ITAAC and Design Acceptance Criteria (DAC) for the RMCS were defined based only on performance. The selection of the actual hardware for the RMCS may not actually occur until late in the application process for a Combined Operating License (COL) or even after construction begins. NRO Instrumentation, Controls, and Electrical Engineering Branch 1 or 2 (ICE1or ICE2) will assist the inspector by making the determination, if required, as to which RMCS is ready for inspection. The inspector should determine if required design reviews have been performed as part of any inspections of specific RMCS that are associated with Design Acceptance Criteria (DAC).

b. Selection of RMCS.

1. Select one or more components for each of the Radiation Monitoring systems listed in the DCD or in some cases an entire Radiation Monitoring system when appropriate for the inspections at the factory and for the installation and testing of RMCS at the specific nuclear plant.

Guidance. The seismically qualified (SQ) and environmentally qualified (EQ) equipment should receive the highest priority in selection, but a cross section of the equipment systems should be assessed by the inspector or over time by the inspection process. The qualification description of various types of RMCS is listed in the DCD. The inspection should focus on RMCS that provides the information used by operators to address an accident or an event, and to prevent the potential release of radiation to the environment. The licensee should have procedures that indicate the manual actions taken by operators based on the available indications in the MCR. The following are some examples of RMCS that may be selected.

(a) Containment Monitoring and Main Control Room Monitor.

Guidance. Examples of RMCS used for technical specification action requirements and emergency action limits during events are Containment High Range and Containment Atmosphere Monitors. The Main Control Room Radiation Monitor is included in this group due to SQ requirements. Associated and interrelated equipment components include: signal processing components, microprocessors, data communication links and transmitters, resets, instrument housings, racks, panels, and associated supports. Examples of processes used in the engineered safety features like control room ventilation actuation include in addition to manual actuation: high area radiation and high radioactive particulate or gas. The FSAR should include the specific variables, as well as the logic and logic devices, used in the system. Actuation of the ESF actuation system (e.g., Control Room Habitability, Stand-by Gas Treatment) may be achieved through multiple means.

(b) Process Radiation Monitoring.

Guidance. Examples of Process Radiation Monitoring used to monitor the equipment engineered for safety to limit plant releases and assess systems

during operation include monitors for: blow down, component cooling and service water, main steam line, and primary system liquid and gas. The FSAR should include the specific variables, as well as the logic and logic devices, used in the systems.

(c) Effluent Monitors.

Guidance. These are RMCS that provide the information used by operators to assess release of radiation to the environment. The licensee should have procedures that indicate the manual actions taken by operators based on reliance on the available indication in the MCR. Examples of the effluent monitors are the ones for plant ventilation normal range particulate-iodine-gas, mid-range gas, high range gas, turbine building vent, containment air exhaust, gaseous and liquid radwaste discharges, and wastewater discharge.

(d) Airborne Monitors

Guidance. The Airborne Monitors used for safety related and environmental control for example may be located in the fuel handling, Auxiliary, Annex, Chemistry Laboratory, RadWaste and Machine Shop exhaust systems. Portable monitors will be installed later, and if they are not part of the permanently attached equipment then they are not part of this inspection module.

(e) Area Monitors

Guidance. In addition to the monitors in the main control room HVAC system, area monitors are installed in the control room to assess occupational safety. Other examples of these monitors are found in the Technical Support Center and the Primary System Sampling Station area. Area Monitors may be installed in other locations in the plant. Consult the DCD for the particular plant being inspected.

02.02 Inspection Activities.

a. Design and Fabrication.

1. Confirm for each of the selected RMCS equipment, that the original design (or approved deviations from the original design) that the licensee/contractor has maintained the SQ of those RMCS that must have SQ as indicated in the DCD or FSAR.

Guidance. Direct observation of some performance based Category I SQ testing is preferred during the planning, testing, or conclusion stage(s) as available. In lieu of observations, review of licensee audits should be completed. The seismic Category I equipment should be able to withstand seismic design basis loads without loss of safety function. Review of test or analysis documentation is also possible. The documentation of Class 1E equipment should be clearly marked on the drawings, “Nuclear Safety Related”. The documentation including all changes

to the original design should be reviewed to assure that the testing or analysis parameters and the relationship of the test(s) or analyses to the design basis event have equivalency. Verify that the safety related documents are complete. Any pre-assembly of Radiation Monitoring equipment prior to installation into the plant should be bounded by the test or analysis.

2. Confirm that each selected RMCS matches the original design. Alternatively, after reviewing available contractor design changes or deviations from the original design, that the licensee/contractor has maintained the EQ of the selected RMCS requiring it as so indicated in the DCD or FSAR.

Guidance. Direct observation of some EQ testing is preferred. In lieu of direct observation, records should be reviewed that report contractor inspection activities by the licensee. The licensee's records should indicate that they performed audits at the contractor's facility of EQ tests or analyses. All EQ equipment should be able to function for the worst-case environmental conditions for their locations in the plant.

3. Digital systems and components like microprocessors have hardware and software QA and configuration management plans.

Guidance. The selected RMCS should be assembled and handled in accordance with these plans. These plans should address the functional requirements, documentation and review, factory and installation tests, verification and validation, problem reporting and training for qualified equipment. These plans should state the controls put in place for the hardware and software for their entire life cycles from inception through factory testing and final shipment. The inspector is not doing a detailed design review, but a verification that these plans exist and address the appropriate requirements. The licensee's records should indicate that they performed audits at the contractor's facility and verified that the contractor followed a hardware and software QA plan, that factory testing was performed, and any failures of components were promptly resolved. The licensee's records should indicate the results of those audits and any onsite reviews and whether the results were satisfactory.

4. Assure that cleanliness requirements have been maintained or otherwise satisfied.

Guidance. This is a manufacturing or assembly facility assessment. The cleanliness of a component should meet the construction specification or contractor's manual and must be appropriate for its environment. This is especially true for digital instrumentation and any associated software and electronic components. The contractor installation records should indicate that the contractor's requirements were met and if not the justification for not meeting them or how the licensee plans to meet those requirements.

5. Verify that the contractor identified and controlled all nonconforming conditions.

Guidance. All nonconforming conditions should result in the appropriate

documentation in accordance with licensee/contractor procedures and regulations in 10 CFR 21. All corrective actions must be reported and be in accordance with licensee/contractor procedures.

b. In-Process Installation.

1. The following licensee activities are controlled, inspected, and accomplished in accordance with the requirements of the procedures reviewed in accordance with IP 65001.

2. Verify that the required identification is properly maintained or established for the selected RMCS.

Guidance. The selected RMCS should be identified including panels, racks, and field mounted components.

3. The latest approved revision of applicable construction specifications, drawings, and/or construction procedures are available and used by the installers.

Guidance. Drawings, construction specifications, and procedures used in the field should be reviewed periodically to ensure that the most recent approved revisions are being used and that there are no missing or inappropriate approvals. The installation records should indicate that the latest approved revisions of the documents were used.

4. Verify that the characteristics of the selected RMCS are as specified, such as type, range, EQ, SQ, and material.

Guidance. The general information contained on the construction specification should be verified for each selected RMCS, and they should be qualified for the environment in which they are located during and following installation. Parts of this assessment can be verified by data in the construction specification or contractor manual. This applies to field-mounted and panel or rack-mounted components and to the panels and racks themselves. For EQ and SQ to be maintained, the installation should be bounded by the test reports or analyses. IN 97-45 discussed how post-accident temperature transients inside containment could lead to thermal induced currents in safety-related cabling which could result in temporary, erratic readings from the containment radiation monitors. Assure that the equipment installed in the containment and other areas of the plant could respond as designed in the event of severe temperature transients. Even equipment designed for a non-harsh environment must be rated to function in that environment. In addition, instrumentation systems must have the appropriate ratings for their components, for example, surge withstand capability (SWC), electromagnetic interference (EMI), electrostatic discharge (ESD), and radio frequency interference (RFI). The FSAR should identify and describe all RMCS which must operate in a harsh environment defined by high radiation, temperature, pressure, vibration or humidity during or subsequent to an accident such as a loss of coolant accident (LOCA), or high energy-line break (HELB). Installation records should be used to indicate that the proper components were installed as indicated

on the design drawings and construction specifications.

5. Verify that mounting hardware and supports are of the type and material specified and properly located in the plant.

Guidance. The subject of anchorage and supports is pertinent to the equipment, racks, and panels for SQ and EQ equipment. For some of the supports and anchorages, the inspector should directly measure or otherwise independently verify that requirements pertaining to such items as location of equipment, location of supports, and bolt size are as specified. This activity is important to the as-built SQs for some instrumentation and should be clearly delineated in the installation documentation. The inspector may choose to not limit this inspection activity solely to the SQ and EQ equipment. For example, during installation of equipment, anchorage holes are sometimes drilled in concrete structures. Indiscriminate cutting of reinforcing steel should not be allowed. So although the inspector is reviewing RMCS, a broad review of the construction activities is always necessary.

6. Verify that the selected RMCS are installed in the proper location and orientation by qualified craft personnel using suitable equipment and tools.

Guidance. Use construction drawings and specifications, training records and visual verifications. The physical installation should have the necessary elements to facilitate monitoring of the plant specific effluents. Consideration should be clearly made for the physical characteristics of the sampling equipment for the effluent being sampled. For example, the contractor may specify limits on the number of 90 degree bends allowed in the sampling lines or require heat tracing to maintain the temperature of the sample in order to have proper sampling.

7. Inspect selected RMCS after installation to ensure that they are adequately protected from damage by adjacent construction activities.

Guidance. The damage could be inflicted by heat, water, power lines, falling equipment, etc.

8. The corrective actions undertaken for problems identified during the installations of the selected RMCS should be effective.

Guidance. The inspector should select 1 - 2 problems that are more significant than a missing screw or an improperly labeled component. The effectiveness of any corrective actions is determined by whether the problems are recurring or not. The licensee should determine the root causes of the problems, and the corrective actions should address the root causes not the problems themselves. When the corrective actions are not effective, the inspector informs both the licensee and NRC management. The installation records should indicate what corrective actions were required for problems encountered during the installation of the RMCS.

9. Review records to assure that nonconforming RMCS or conditions have been identified and controlled in accordance with approved procedures.

Guidance. The intent is to verify that nonconforming conditions are identified and result in the initiation of appropriate nonconformance documentation in accordance with 10 CFR 21. Where revisions are made, verify that they are in accordance with approved corrective action dispositions. The installation records should indicate any non conformances and how each was processed.

10. The records of the in-process activities are in accordance with licensee procedures and NRC regulations.

Guidance. The records should be all the installation records including those suggested in the guidance for the proceeding steps of the in-process work activities.

c. Completed Work/As-Built

1. The following licensee activities are controlled, inspected, and accomplished in accordance with the requirements of the procedures reviewed in accordance with IP 65001.

2. Review the as-built installations for the RMCS.

Guidance. For as-built installations, including the Containment High Range monitoring equipment, Containment Atmosphere and Main Control Room monitoring equipment, and the remainder of the selected RMCS requiring SQ, as indicated by the DCD or FSAR, should still be seismically bounded by the tests or analyses of the licensee or contractor. The EQs of the selected RMCS as indicated in the DCD or FSAR should also still be bounded by their appropriate tests or analyses so that those qualifications are still maintained for their as-built installations.

3. Verify that the selected RMCS and associated items maintain physical and electrical independence between redundant channels or systems.

Guidance. IEEE Standard 279 requires channels that provide signals for the same protection function be independent and physically separated. This physical and electrical independence should be true for all redundant RMCS required for safety assessment and accident mitigation. This is for the components comprising the instrumentation channels within a Radiation Monitoring system. The inspector should determine how the contractor intended to meet this requirement and whether the as-built installation meets that requirement. This is not meant to be a validation of the design but whether the completed installation meets the design requirements. Electrical independence also includes being powered by the right power source. The installation records should indicate any deviation between the design basis and the as-built installation.

4. Verify that displays on MCR panels and at other panels used by operators are mounted at the correct locations.

Guidance. The displays should not only be mounted correctly but be functional in accordance with contractor specifications. ANSI N13.10 recommends alarms for

detection levels but also to alert operators of equipment inoperability. Additionally, the installation records of the licensee should indicate the results of this review. Depending on MCR designs and evolving digital technology, MCR readouts may not be dedicated components.

5. Verify that the selected RMCS, in the completed installation, conform to elementary layouts of the systems.

Guidance. This review is an expansion of the review for the selected components. This is a fundamental check that the system has the required types of inputs, outputs, displays, and controls. The installation records should indicate any deviations of the systems as installed from their elementary layouts.

6. Verify that the correct RMCS have been used. Verify that they have been correctly and permanently identified.

Guidance. Sometimes similar Radiation Monitoring components are put in identical cases. The inspector should determine that the RMCS inspected are as specified. This can be done by observing the name plate for specific characteristics unique to that component and comparing them against the construction specification for that component. A component's identification should be in agreement with construction drawings and specifications and be adequate for the location of the component. The installed instrument components should be uniquely identified on the component itself, the installation records, calibration records, and inspection records. For panel or rack-mounted components, the component may have its own identification but the panel or rack should also be identified. For a variety of reasons, the identification of components previously reviewed during the in-process installation inspections may have been disturbed. This is a final verification that the identification is still correct, and the installation records should indicate the components were identified per drawings and specifications.

7. The records of the completed work and as-built activities are in accordance with licensee procedures and NRC regulations.

Guidance. The records should be all the installation records including those suggested in the guidance for the proceeding steps of the completed work activities.

d. Construction and Operational Testing. The inspector should observe construction and operational testing for some of the RMCS in the inspection sample by performing the following sub steps below:

Guidance. This section combines construction and operational testing. The first is the preliminary testing to verify that components and systems are correctly installed and operational. Operational testing is a verification that components and systems operate in accordance with their design criteria. This section will not further segregate between the two, but the following steps will address both.

1. The test activities, reviewed in the following sub-steps, should be controlled, inspected, and accomplished in accordance with the requirements of the

procedures reviewed in IP 65001.

No specific guidance

2. Test and calibration personnel adhere to any special handling or removal requirements.

Guidance. Test and calibration personnel should be knowledgeable in the special care and handling that should be exercised when readying sensitive RMCS for testing. The inspector should be especially mindful of those injudicious actions that could cause the systems or components to operate in a manner uncharacteristic to their test specifications or design basis.

3. The latest revisions of applicable procedures and/or specifications are available at the test location and used by personnel performing the testing and calibration.

Guidance. The inspector should periodically check that the latest test procedure is being used during the test. The inspector should review the specified calibration requirements and procedures before observing these activities. If special requirements are specified, such as density compensation during liquid level instrument calibration, the inspector should determine whether those requirements are met. All testing should be in accordance with licensee commitments and manufacturer's recommendations.

4. Properly identified, traceable, and calibrated measuring and test equipment are used.

Guidance. If calibration activities are in progress, determine whether the most recently approved calibration information is being used, and whether there is compliance with the required procedures. The values of instrument ranges and zero set points are sometimes changed after receipt of the instruments at the site. The inspector should assure himself (by selective sampling) that current data are used for checking and calibrating instruments, and that these changes are within the limits of the instrument components involved.

5. RMCS are able to obtain the desired set point, degree of accuracy, and/or tolerance specified or otherwise noted.

Guidance. As these inspection requirements cannot be done until testing and calibration activities are in progress, inspection in this area should be scheduled accordingly. For digital RMCS, the setpoints or tuning parameters embedded in the software should be treated like any other setpoint. A download of setpoints and coefficients by the licensee could be compared to RMCS requirements documentation.

6. Required testing and calibration results are recorded during the activity, not after the work has been completed.

Guidance. Final calibration and trip settings should be done during the final testing

of the system or component.

7. The power, grounding, and shielding, if applicable, are in accordance with the design basis and NRC SER.

Guidance. Test signals may be utilized to test if the systems and components are powered from the correct power division. Grounding and shielding of electronic and digital systems and components should be carefully addressed and be in accordance with the manufacturer's recommendations.

8. Automatic and manual actuations and responses of RMCS are per the design basis.

Guidance. The following pertain to the responses of RMCS to either simulated or actual signals or inputs. Whether the signals are actual or simulated is not really pertinent to whether the RMCS perform in accordance with the design basis. The inspector can check for any of the following:

(a) After the required input, RMCS actuate or inhibit process systems.

(b) The manual actuation of process RMCS is performed from operator stations like the MCR or RS panels.

(c) Safety-related displays provide the correct information.

9. RMCS are adequately identified as having been tested or calibrated.

Guidance. The licensee in some fashion should indicate what RMCS have been tested and whether there are outstanding concerns that could possibly invalidate the tests as conducted.

10. Personnel performing the testing and calibration are properly qualified.

Guidance. "Qualified test personnel" means those employees who have achieved suitable proficiency to do their assigned tasks by appropriate training and/or previous experience and who understand the test procedures, drawings, and specifications necessary for the testing to be conducted.

65001.19-03 RESOURCE ESTIMATE

This IP supports the review of RMCS for any reactor design. The resource estimate for this IP is approximately 240 hours of direct inspection effort each time this whole procedure is implemented.

65001.19-04 REFERENCES

ANSI N13.1-1969, Guide to sampling airborne radioactive materials in nuclear facilities

ANSI N13.10-1974, Specification and Performance of On-site Instrumentation for Continuously Monitoring Radioactivity in Effluents

ANSI 41.28-1976, IEEE Standard Method for Identification of Documents Related to Class 1E Equipment and Systems for Nuclear Power Generating Stations

IEEE 279-1971 - Criteria for Protection Systems for Nuclear Power Generating Stations

IEEE Standard 572-1985, Qualification of Class 1E Connection Assemblies for Nuclear Power Generating Stations

IN 97-45, Environmental Qualification Deficiency For Cables and Containment Penetration Pigtails

NSI/ANS 8.3-1997, Criticality Alarm

NUREG-1211, Regulatory Analysis for Resolution of Unresolved Safety Issue A-46, Seismic Qualification of Equipment in Operating Plants

Regulatory Guide 1.29, Seismic Design Classification, Revision 3

Regulatory Guide 1.97, Criteria for accident monitoring instrumentation for nuclear power plants

Regulatory Guide 1.156 Environmental Qualification of Connection Assemblies for Nuclear Power Plants

END

Attachment 1 – Revision History for IP 65001.19

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Revision History for 65001.19

Commitment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
N/A	10/20/08 CN 08-029	1. Initial issuance to support ITAAC related inspections under 10CFR52. 2. Researched commitments for 4 years and found none.	None	N/A	N/A