IAEA TECDOC SERIES

IAEA-TECDOC-1867

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Handbook for Regulatory Inspectors of Nuclear Power Plants

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HANDBOOK FOR REGULATORY INSPECTORS OF NUCLEAR POWER PLANTS

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FOREWORD

The primary purpose of regulatory inspections is to independently provide a high level of assurance that activities performed by the authorized party are in compliance with applicable laws, regulations and conditions of authorization. The regulatory body performs inspections of a sample of the authorized party's activities. These activities are selected using a graded approach consistent the level of risk added by the activity. When inspections find that the facility or activity is not in compliance with regulations or authorization conditions, the inspector or regulatory body needs to consider enforcement actions to ensure that compliance is re-established. Regulatory inspections do not relieve the licensee's prime responsibly for safety in accordance with the Fundamental Safety Principles (IAEA Safety Standards Series No. SF-1).

To effectively and efficiently implement the inspection programme, the regulatory body needs to have well trained and qualified inspectors. However, as the nuclear industry continues to mature, inspectors are leaving the industry and new inspectors are replacing them. In addition, more Member States are considering including or increasing the use of nuclear power in their national energy strategies. Therefore, additional inspectors worldwide will require training and qualification. Experience has shown that the training and qualification of new inspectors takes approximately one and a half to two years.

This handbook is intended to enhance the effectiveness and efficiency of the regulatory inspector. It is designed to address the needs of regulatory inspectors in developing and enhancing their inspection skills for nuclear power plants. The handbook walks through how an inspector prepares for and conducts inspections, including methods for using a graded approach to select systems, structures and components for inspection and for evaluation of the significance of inspection findings. While this publication is intended for the training and development of new regulatory inspectors, it can also be used by experienced inspectors when inspecting new activities and when mentoring new inspectors.

This publication is the product of experts from different regulatory bodies and provides a broad view of inspection techniques and methods. The IAEA wishes to acknowledge the efforts of the participating experts. The IAEA officers responsible for this publication were T. Kobetz and J. Hopkins of the Division of Nuclear Installation Safety.

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1. INTRODUCTION

1.1 BACKGROUND

The IAEA has developed and implemented numerous workshops and training activities on the regulatory inspection of nuclear power plants (NPPs). While these are mostly focused toward Member States that are embarking on nuclear power programmes, the goal of the workshops and training is to assist their staff in learning the skills necessary to inspect the construction and operation of an NPP.

The publications identified below provide the main IAEA guidance on performing inspections at NPPs. The IAEA Safety Standard GSR Part 1 (Rev. 1) Governmental, Legal, and Regulatory Framework for Safety [1], requires that regulatory bodies carry out inspections of nuclear facilities and activities. The IAEA Safety Guide GSG-13, Functions and Processes of the Regulatory Body for Safety [2], provides guidance on inspection as one of the regulatory body's core functions as defined in GSR Part 1 (Rev. 1) [1], in the framework of the associated processes illustrated by the IAEA Safety Guide GSG-12, Organization, Management and Staffing of the Regulatory Body for Safety [3] for ensuring the regulatory control of facilities and activities. The IAEA Safety Reports Series No. SRS-81, Development of a Regulatory Inspection Programme for a New Nuclear Power Project [4], provides specific examples of how to establish a regulatory inspection programme.

1.2 OBJECTIVE

The objective of this publication is to provide regulatory inspectors with practical guidance for planning and performing inspections at NPPs. Using the information in this publication will enhance the effectiveness and efficiency of the regulatory inspector. It is designed to address the needs of regulatory inspectors in developing and enhancing their inspection skills for NPPs. The handbook walks through how an inspector prepares for and conducts inspections including methods on how to use a graded approach to select systems, structures and components (SSCs) for inspection and for evaluation of the significance of inspection findings.

The inspection areas discussed in the handbook are not all inclusive but reflect some of the more safety significant SSC and activities that could be considered. This handbook is not intended to cover all inspection areas and is not to be used as the only inspection guidance by a regulatory body but could be used to supplement its overall inspection programme.

This publication supplements IAEA workshops and training for inspectors in embarking countries as well as providing refresher information for experienced inspectors. It also provides information that will be useful for experienced inspectors when mentoring new inspectors.

1.3 SCOPE

This publication addresses inspection basics, concepts and methods on how to plan inspection activities, perform inspections of safety related SSCs, evaluate the safety significance of inspection findings, and document the inspection results and findings.

In addition, this publication presents high level considerations for the inspection of selected programmatic areas including radiation protection, waste management, conduct of operations and corrective action programmes at NPPs. Other aspects of human and organisational factors including inspection of safety culture and leadership, management systems, fitness for duty, and training and qualification to name a few are not discussed in this publication. Inspection of security, safeguards, or emergency response activities and equipment are also beyond the scope of this publication.

This publication focuses on the regulatory inspection of operating NPPs and, when applicable, describes how the same inspection techniques can be applied to facilities undergoing construction, preoperational testing, and decommissioning. The general techniques described may be also used in the inspection of other types of nuclear facilities.

1.4 STRUCTURE

This TECDOC describes fundamental concepts and methods for planning, performing, evaluating, and documenting the results of inspections of safety related activities at NPPs. The publication provides practical guidance for regulatory inspectors as they prepare for and conduct inspections including the use of a graded approach to select systems, structures and components (SSCs) for inspection and for evaluation of the significance of inspection findings.

Section 2 describes the IAEA general guidance for regulatory inspections, different types of regulatory inspections, and various regulatory inspection methods. Section 3 provides guidance for planning, performing, evaluating, and reporting the results of regulatory inspections. It also describes the importance of regulatory inspectors' conduct and objectivity. Sections 4 and 5 describe detailed, practical guidance on performing inspections of specific components and different areas of the plant during different operational stages. This publication also includes one Annex consisting of inspection guides and specific questions which the inspector may find useful during plant inspections.

2. GENERAL GUIDANCE FOR INSPECTIONS

2.1 IAEA SAFETY STANDARDS FOR INSPECTION

The main IAEA requirements and recommendations are in:

- GSR Part 1 (Rev. 1), Governmental, Legal, and Regulatory Framework for Safety [1];
- GSR Part 2, Leadership and Management for Safety [5];
- GSG-12, Organization, Management and Staffing of the Regulatory Body for Safety [3];
- GSG-13, Functions and Processes of the Regulatory Body [2].

For the purposes of this handbook, the terms **licensee** and **authorized party** are interchangeable and are used to identify the person(s) or organization(s) which are licensed or authorized to operate the facility and have the prime responsibility for the safe operation of the facility. This may be an individual or group who has been licensed, authorized, or certified by the State to perform regulated activities using radioactive materials.

GSR Part 1 (Rev.1), Requirements 27, 28 and 29, define the inspection process [1]. The regulatory body has the duty of oversight of all safety related activities in all phases in the life of a nuclear installation—site characterization, design, construction, commissioning, commercial operation and shut down and dismantling—to verify that the limits and conditions in the licence are complied with and that all applicable regulations are properly respected. These oversight activities do not diminish the authorized party's prime responsibility for safety. Oversight can be conducted by analysing reports and through inspections.

GSR Part 1 (Rev. 1), Requirements 30 and 31, address the enforcement function when noncompliance with regulations are discovered by inspectors or reported by the authorized party [1]. The enforcement response can vary from warnings to prosecution, depending on the nature of the noncompliance. In all cases, the authorized party is normally provided with an opportunity to provide arguments against the enforcement action.

GSR Part 2 [5] establishes requirements that support Principle 3 of Fundamental Safety Principles, SF-1 [6], in relation to establishing, sustaining and continuously improving leadership and management for safety, and an effective management system. This is essential in order to foster and sustain a strong safety culture in an organization. Another objective is to establish requirements that apply Principle 8 of SF-1, which states that “All practical efforts must be made to prevent and mitigate nuclear or radiation accidents.” [6]

GSG-12 [3] states that the regulatory body be organized in a way that ensures that inspection activities are coordinated. GSG-12 [3] also provides advice on the personal qualities needed of inspectors and outlines an inspector training programme. Proposed guidance on the development of these two core processes can be found in Annex II of GSG-12 [3].

GSG-13 [2] provides extensive guidance on regulatory inspection and enforcement by the regulatory body. GSG-13 [2] identifies a large number of areas in addition to compliance matters that the regulatory body may need to inspect to provide a high level of confidence that safety objectives are met. GSG-13 [2] also provides extensive guidance on how to manage, organize, perform, and report on inspections over the entire installation lifetime. GSG-13 [2] also recommends that the regulatory body periodically assess the inspection programme for its continued effectiveness. On enforcement, GSG-13 [2] discusses the factors relating to various enforcement options and highlights the importance of management of the enforcement process and the need to document enforcement decisions.

2.2 PURPOSE AND GOALS OF REGULATORY INSPECTIONS

The primary purpose of regulatory inspections is to independently provide a high level of assurance that activities performed by the authorized party are in compliance with the regulatory requirements and with the conditions specified in the authorization or license. The Regulatory Body performs inspections of a sample of the authorized party’s activities. These activities are selected using a graded approach consistent the level of risk added by the activity. When inspections find that the facility or activity is not in compliance with regulations or license conditions then the inspector or regulatory body may take enforcement actions to ensure that compliance is re-established.

Regulatory inspections do not relieve the licensee’s prime responsibly for safety in accordance with SF-1, Principle 1 [6].

Specifically, inspections are performed to determine that the licensee is complying with all applicable laws, regulations and license conditions and all relevant codes, guides, specifications, and practices. For example:

- The authorized party has in place an effective management system and a strong safety culture and self-assessment systems for ensuring the safety of the facility or activity and the radiation protection of people and the environment;
- The required quality and performance are achieved and maintained in the safety related items and activities of the authorized party throughout the lifetime of the NPP;
- Persons employed by the authorized party (including contractors) possess the necessary competence for the effective performance of their functions;

- Deficiencies and abnormal conditions are identified and promptly evaluated and remedied by the authorized party and duly reported to the regulatory body as required;
- Any other safety issue that is neither specified in the authorization nor addressed in the regulation is identified and appropriately considered;
- Any lessons learned are identified and propagated to other authorized parties and suppliers and to the regulatory body as appropriate.

2.3 INSPECTION BASICS

2.3.1 Types of regulatory inspection

Inspections of facilities and activities consist of a predefined programme of planned inspections and reactive inspections which are both announced and unannounced to ensure that the inspectors obtain a clear understanding of the overall operation of the NPP. Inspections are normally carried out using a graded approach to ensure the safety related SSCs and risk significant activities receive the most attention.

For an announced inspection, the licensee is notified in advance by the regulatory body. The main advantage of announced inspections is that the regulatory inspector can discuss plans and needs with the licensee's personnel in advance in order to secure assurances that documentation will be available for inspection, personnel will be available for interview and activities can be inspected as scheduled. Hence, the announcement of inspections may enhance their effectiveness.

The regulatory body needs to consider the timing of the announcement of the inspection which may vary according to the circumstances of the inspection to be performed. Inspections may be announced, for example, when the regulatory body wishes to observe a specific activity, to inspect a specific self-assessment by the licensee while it is in progress, or to interview a specific member of the licensee's staff.

Unannounced inspections are also part of the regulatory body's programme of inspections. However, an unannounced inspection is not notified in advance to the licensee by the regulatory body. Unannounced inspections are otherwise planned and carried out following the regulatory body's established processes. Unannounced inspections may be carried out at any time of the day or night. One advantage of an unannounced inspection is that the actual state of the facility and the way in which it is being operated can be readily observed. The inspectors may obtain a more complete picture of the situation at the facility. While unannounced inspections have benefits, however, the regulatory body needs to be sensitive to activities on going at the site and to avoid unnecessary burden on the licensee.

2.3.1.1 Planned inspections

Planned inspections, either announced or unannounced, are part of a structured and largely predefined inspection programme developed by the regulatory body. The inspections may be linked to the licensee's schedules for the performance or completion of certain activities at all stages of the licensing process. Planned inspections are scheduled in advance by the regulatory body. Planned inspections provide an opportunity for the examination of the licensee's activities in order to confirm compliance with regulatory and licensing requirements and to identify potential problems at an early stage.

In planned inspections, emphasis is given to the observation and assessment of continuing safety activities in order to assess the effectiveness of the licensee's performance.

The regulatory body normally considers performing inspections of specific issues which may be of interest to the regulatory body. Examples of specific issues include: steam generator replacement; emergency diesel generator overhaul; and other major modifications, refurbishment and maintenance activities. Consideration is normally given to new findings from research and development work, operating experience (both national and international) and regulatory experiences of other regulatory bodies. This type of inspection may range from a single inspector focusing on a specific inspection area to a team inspecting multiple areas.

2.3.1.2 Reactive inspections

In addition to routine inspection activities, the regulatory body also performs inspections on short notice if an abnormal occurrence warrants immediate investigation.

Reactive inspections, by individuals or teams, are usually initiated by the regulatory body in response to an unexpected or unplanned situation, incident or accident in order to assess its safety significance and implications on public health and safety, and to evaluate the adequacy of the licensee's corrective actions. A reactive inspection may be implemented to inspect an isolated incident or a series of lesser events occurring at the facility or activity under consideration. Similarly, a reactive inspection may be made in response to a generic problem encountered at another facility or activity or identified by the staff of the regulatory body.

Unlike planned inspections, reactive inspections are only partly subject to the normal inspection planning process used by the regulatory body and may disrupt regulatory programmes and schedules. The regulatory body needs to consider reactive inspections and plan to meet its needs for staff and external experts accordingly. All available resources may be needed in responding to a serious event, whereas in the simplest of cases only one inspector may be needed. A preestablished graded approach in responding to special circumstances will assist in determining the appropriate level of resources for use in reactive inspections. The regulatory body may consider developing specific guidance to evaluate the significance of incidents and accidents to determine whether a reactive inspection is warranted.

Determining why the abnormal occurrence or incident happened is of central interest with regard to safety. Therefore, reactive inspection normally includes a detailed inspection plan, including confirmation that the licensee has completed or will complete:

- The determination of the root causes, the sequence of events and the contributory factors;
- The assessment of the consequences;
- The identification of preventive and corrective actions;
- The documentation of lessons to be learned.

Following the inspection, the regulatory body evaluates:

- The adequacy of the corrective actions taken by the licensee and the necessity of any further actions by the licensee;
- The recommendations of measures to be taken for the prevention of similar events in the future, including changes in the regulatory programme, as well as any adjustments in the safety programmes of authorized parties;
- The dissemination of all findings, lessons to be learned and recommendations to relevant authorized parties, manufacturers and suppliers, both nationally and internationally.

2.3.1.3 Team inspections

Team inspections are normally used when the inspections cover multiple areas and disciplines to provide an in depth, independent and balanced assessment of the licensee's performance. This type of inspection may vary in both scope and complexity. Team inspections are of particular value once safety problems have been identified, since other inspections may cover only small samples of the licensee's activities in any area.

Inspections of this type identify underlying causes of problems in order to determine whether a safety concern represents isolated cases or may signify a broader, more serious problem.

Different approaches are used in planning team inspections. Some team inspections may be broad in focus and cover a wide subject area ('horizontal slice') in the programme area of interest. For example, during NPP operations a team of inspectors may assess the performance of operations at a facility or of a specific activity. Additionally, a team of maintenance and engineering inspectors may assess activities during an outage. Other team inspections may be narrow in focus and cover a smaller subject area ('vertical slice'). For example, an inspection may involve an in-depth inspection of a single safety system in order to confirm that the system is in full compliance with the regulatory requirements. Another example is a team may inspect the same safety aspect at similar facilities.

2.3.2 Inspection methods

GSG-13[2] identifies four basic methods for obtaining information during an inspection: Monitoring and Direct Observation; Discussions and Interviews; Document Evaluation; and Independent Tests and Measurements. Depending on the type of inspection being performed, the inspector must determine the method, or methods, which would be best to gather and evaluate the required information and data. The basis methods identified below are simply brief descriptions and are not intended to replace the regulatory body's procedures and formal inspector training program.

2.3.2.1 Monitoring and direct observation

This inspection method involves the direct observation of activities in the NPP. Monitoring and Direct Observation are performance-based inspections that allow the inspector to determine whether the licensee is following procedures and meeting the regulatory requirements while performing their activities. The observations may be general in nature or may be focused on specific activities in order to gain an overall impression of the licensee's capabilities and performance.

Direct observations are best for performing most of the inspections discussed in Chapter 4, and include but are not limited to:

- Control room and shift turnovers;
- Routine and off normal operations both in the control room and in the NPP;
- Plant inspections safety related equipment;
- Maintenance and surveillance activities;
- Pre-job briefings;
- Radiation protection including boundaries of controlled areas;
- Fire protection.

2.3.2.2 Discussion and interviews

Formal and informal communication with licensee's personnel during routine and off normal operating conditions are used to learn about, and understand, potential safety issues that may not be revealed during the inspector's observation of activities. Discussions with personnel are especially important in follow-up investigations to reconstruct events and assess the licensee's response.

While the inspection of safety culture is not specifically discussed in this publication, insights on how leadership and management promote and foster a strong safety culture can also be obtained during discussions with personnel. For example, the answers to the question of whether safety is promoted at all organizational levels over schedule during plant outages and non-routine operations may provide some insight to the safety culture of the licensee.

The regulatory body's legal authority normally provides unfettered access to speak with anyone on site at any time. The licensee's guidance documents, policies, and procedures must not interfere with or diminish the inspector's access to plant personnel in any way. Regulatory inspectors may request interviews on a specific topic or with a specific individual. However, the inspector must not abuse that authority and needs to be sensitive to the ongoing activities at the facility. Additionally, the interview or discussion must be always conducted in a respectful manner.

2.3.2.3 Interview techniques and good practices

Conducting an interview is a learned skill. With training and practice, the inspector can control and direct the interview with different types of questions to obtain specific information.

Below is some information the inspector may find useful when preparing for an interview and during the interview. This information is intended to be an additional tool to use during your assessment of the licensee's activities. This information is not intended to replace a formal course on interviewing techniques or the regulatory body's inspector training program.

(i) Role of the inspector

During the interview, the inspector has many roles including:

- Obtaining, clarifying, and confirming information;
- Remaining neutral and objective;
- Being professional and a credible ambassador for the regulatory body;
- Listening;
- Keeping on track;
- Probing for clarification;
- Summarizing key points.

During an interview, the inspector must display qualities such as tact, diplomacy, objectivity, and maturity. The inspector must also apply some general techniques during the interview, such as:

- Being prepared with written questions;
- Putting the person being interviewed at ease;
- Asking open ended questions;
- Not interrupting;
- Summarizing what has been said to ensure a mutual understanding with the interviewee.

The combination of these qualities and general techniques will provide the inspector with the basic tools needed to obtain the relevant information.

(ii) Interview questions

The amount of preparation and the quality of the questions will determine if the inspector obtains the needed information. Listed below are some general characteristics for high quality, effective interview questions.

Effective questions are:

- To the point and focused on safety and regulations;
- Open ended. For example, they start with the words like **describe** or **explain**;
- Singular and help focus the interviewee's thoughts;
- Clear so the interviewee understands why the question is being asked and why it is pertinent;
- Not leading, so that the phrasing does not lead toward an **expected** answer.

Different types of questions are used to obtain different types of information. Below are some examples of types of questions the inspector may find useful when preparing for an interview.

- **Overview questions:** These are questions that give the interviewee the opportunity to explain the concepts or programme being inspected. An example would be "In your own words, could you give an overview of the maintenance programme?"
- **Inventory questions:** These are questions about specific aspects of the activity which is being inspected. They are typically worded as: "In what ways did you…? or to what extent do you…?"
- **Process clarification questions:** Typical wording of these questions include: "Help us understand how this works? Under what circumstances would this have occurred? Could you give an illustration of how…?"
- **Probes for clarification questions:** Typical wording of these questions include: "You just mentioned the term xxx, please explain that term? You just mentioned xxx. Please tell us more about that."
- **Probes for absences questions:** Typical wording of these questions include: We haven't heard anything about xxx. Help us see where we could find out more about this.
- **Probes for negative instances questions:** Typical working of these questions include: We see you have a policy on xxx. Can you give us instances where it worked like that? Are there any instances where it didn't work like that?

(iii) Conducting the interview

Each interview is a unique event. Each set of questions and responses creates new paths to follow, so the inspector must control the flow of the information and remain focused. Separate the interesting information obtained during the interview from the useful information. Let the useful information steer the direction of the interview and determine the next questions. Below are some techniques and advice on how to plan and conduct an interview to obtain the desired information.

At the beginning of the interview:

- Thank the interviewee, explain the purpose of the interview, and introduce yourself and others as needed;
- Try to put the person at ease, but maintain a professional, formal tone;
- As much as possible, have the interview in a location where the person being interview feels comfortable. This may be their office or work area, or it may be a private area such as the inspector's office. If necessary, have the interview (or part of the interview) in an area where documents the inspector wants to see are readily available;
- Let the interviewee know how much time the interview will take;
- Tell the interviewee that you will be taking notes. Let them know that the number of notes taken is not an indication of an answer being correct or incorrect. The notes are a quick reminder for the inspector if additional follow up is required;
- If possible, have two people involved in the interview; one to ask questions and one to take notes. Do not gang up on the person being interviewed by having each inspector asking questions in a rapid manner;

- Be prepared if the person being interviewed wants another licensee staff member to be present during the interview. The inspector must clearly understand the regulatory body's position regarding this matter.

Remember that the interview is not about the inspector. Avoid talking about your experiences or giving your opinions. Listed below are some Do's and Don'ts to keep in mind during the interview.

Do's:

- Ask clear, concise, one-part questions;
- Ask one question at a time;
- Probe, but do not prompt;
- Ask for clarification when necessary;
- Ask for supporting documentation;
- Separate the interesting information from the useful information. Focus on the useful information;
- Focus on the questions and answers;
- Use polite, but neutral, language;
- Demonstrate patience;
- Treat the interviewee as a fellow professional;
- Provide the opportunity for everyone to speak;
- Listen to all the interviewee 's comments and responses;
- Recognize unanticipated information;
- Paraphrase what you hear;
- Clarify to obtain a shared understanding;
- Keep to the time limit;
- Think about how to verify what has been said during the interview.

Don'ts:

- Do not ask terse questions. Be able to explain what information you are seeking;
- Do not be confrontational;
- Do not interrupt;
- Do not use judgemental language;
- Do not pursue interesting but irrelevant answers;
- Do not be afraid of silence. The interviewee may add useful information if the inspector just remains quiet.

(iv) Concluding the interview

- Ask if the interviewee has anything to add;
- Ask if the interviewee can recommend anyone else who may have relevant information;
- Summarize what you heard;
- Make sure you have contact information for the interviewee in case follow up is needed;
- Thank everyone.

2.3.2.4 Examination of documentation

Documents may be inspected as part of the preparation for an inspection or during an event follow-up inspection. Normally, document examination is used to augment direct observation by assessing the outcomes of past activities. In some cases, performing inspections by monitoring and direct observation may not be possible or not appropriate. Examples of documents that may be inspected include, but are not limited to:

- Control room logs;
- Maintenance and surveillance records;
- Post maintenance test records;
- Corrective action reports and associated corrective actions;
- Design modifications packages;
- Training records (operations, radiation protection, emergency response, etc.);
- Work order and package;
- System descriptions, drawings, and applicable procedures;
- Vendor manuals;
- Technical Specifications, license conditions, and Safety Analysis Report;
- Previous inspection reports;
- Radiation Work Permit (RWP);
- Operating Experience Feedback (OEF).

2.3.2.5 Independent tests and measurements

Confirmatory measurements by inspectors may be used to assess whether the licensee is in compliance with regulatory and licensing requirements. However, under no circumstances is an inspector to operate plant equipment or affect plant operations and safety in any manner when conducting tests and or taking measurements. A typical example of a measurement taken by an inspector would be the independent verification of radiation and contamination levels in specific areas of the plant against the measurements taken by the licensee. There may be additional examples, especially during the construction of a facility.

3. REGULATORY INSPECTION PROCESS

To meet the objectives for regulatory inspection discussed in previous sections, the regulatory body should define an inspection programme which uses a graded approach to assess whether the licensee provides adequate control over safety related SSCs and risk significant activities. The regulatory inspection programme identifies a sample of the licensee's activities for inspection based on the safety significance and the level of risk associated with the SSC or activity.

As shown in Figure 1, an individual regulatory inspection can be viewed as having four phases: planning, performing, evaluating, and reporting (see Fig. 1). In the planning phase, the inspector selects the sample of licensee activities to be included in the inspection and identifies the appropriate inspection procedure(s). In the performance phase, the inspector uses one or more of the four basic methods for obtaining information and identifies observations related to the activities. In the evaluation phase, the inspector determines if the observations are violations of regulatory requirements and if some type of immediate action is needed. In the reporting phase, the inspector documents the results of the inspection including the regulatory body's assessment of the licensee's activities in relation to safety and any necessary follow-up actions, including enforcement actions.

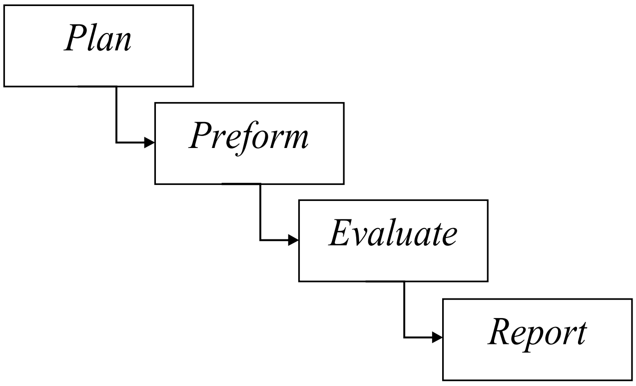

FIG.1. INSPECTION PROCESS

3.1 PLANNING PHASE OF THE INSPECTION

To ensure a successful and thorough inspection, the inspector must plan and prepare for the inspection. The preparations required will depend on the complexity of inspections. For some inspections a well-developed checklist or procedure will exist. However, in some cases (i.e. reactive inspections) the inspector will need to develop the inspection plan. In doing so, the inspector normally considers the following:

- Determine which areas, activities and attributes are to be inspected (see Section 3.1.1 for additional information).

- Identify material to be evaluated
    - Identify the appropriate inspection procedures or checklists for the areas to be inspected;
    - Identify necessary documents from the licensee. The list below gives examples of the types of licensee documents the inspector may wish to consult:
        - Final Safety Analysis Report (FSAR), Preliminary Safety Analysis Report (PSAR), Safety Analysis Reports, etc…;
        - licensing basis documents and design basis documents;
        - plant operating procedures;
        - maintenance and surveillance procedures and associated records;
        - work orders, corrective action reports, system descriptions, plant drawings, piping and instrumentation diagrams;
        - Vendor information for the equipment to be inspected (e.g., technical and operations manuals).
    - Operating experience applicable to the reactor technology (both national and international experience);
    - Findings, violations and enforcement actions from previous inspections relating to the inspection area;
    - Past correspondence between the regulator and the licensee relating to the inspection area;
    - Licensee contacts – those who can provide on-site inspection support.

- Determine inspection methods
    - monitoring and direct observation (such as of working practices and equipment);
    - discussions and interviews with personnel of the licensee and the contractors;
    - examinations of procedures, records and documentation;
    - tests and measurements.

- Estimate time and schedule and inspection resources (including personnel)
    - Identify any specialized knowledge, skills, and abilities (KSAs) needed to perform the inspection and assemble the appropriate inspection team;
    - Provide just in time training, if needed, to ensure the inspectors are properly refreshed in the relevant areas;
    - Provide any specialized instruments and equipment needed to ensure the inspectors are properly equipped to perform independent assessments. This may include personal protection equipment (PPE).

- Address administrative issues
    - Communication with the licensee:
        - formally or informally (depending on the agreements between the regulatory body and the licensee) notifies the licensee of the purpose, size of the inspection team, scope and date of the inspection;
        - Requests documents in advance of the inspection;
        - Confirms agreements on the licensee's requirements for site access for inspectors including PPE;
        - Confirms agreements with licensee regarding the use of photos and videos;

- Finalize inspection plan

3.1.1 Selection of inspection areas

3.1.1.1 General considerations

The regulatory body performs inspections of a sample of the licensee's activities based on the planned inspection programme. Inspectors must use the appropriate inspection procedure and select a sample of activities or areas based on a variety of factors including:

- Regulatory policies, requirements, regulations, guides and industry standards;
- Safety and risk significance based on the fulfilment of the fundamental safety functions, namely;
    - Control of reactivity;
    - Heat removal from the reactor and spent fuel storage facilities;
    - Confinement of radioactive material and shielding against radiation to prevent unplanned radioactive releases.
- Licensee's overall safety performance;
- Regulatory and operational experience at other NPPs locally and worldwide;
- The input from periodic regulatory inspections and assessment activities;
- Likelihood for error (including event/failure modes and effects analysis) and complexity or novelty of the respective activity (e.g. manufacturing, construction, installation, testing, etc.);
- Relevant experience, training, qualification and supervision of the staff performing the activity;
- Opportunities to inspect activities or areas not usually accessible (e.g. entering containment).

Inspection area selection normally considers the increased risk due to:

- On line maintenance activities;
- On line plant modifications;
- The operator's ability to perform safety related compensatory measures within the predetermined specified time limits;
- Compensatory measures for out of service (OOS) equipment.

3.1.1.2 Applying a graded approach to inspection

Using the general considerations above, the inspector uses a graded approach to determine the activities and areas for inspection and the amount of inspection effort that is applied. The inspector needs to apply a structured method which takes into account the safety significance of an activity or of an SSC, including factors such as the complexity of the activity or SSC and the consequences of failure or incorrect performance. For example, in applying a graded approach, the inspector normally considers selecting:

- SSCs that directly affect fulfilment of the fundamental safety functions;
- SSCs that mitigate the consequences of anticipated transients or of other events which may result in the release of radioactive material;
- Activities and areas where the licensee has experienced problems in the past;
- Activities and areas where other NPPs have experienced problems;
- Activities and areas that have been previously identified as needing attention;
- Activities with a high likelihood for error;
- Activities and areas using a novel approach or design;
- Activities and areas not normally accessible.

3.2 PERFORMANCE PHASE OF THE INSPECTION

3.2.1 Entrance meeting

In most cases, entrance meetings are held to ensure that the regulatory body and the licensee have a common understanding of the purpose and scope of the inspection. An entrance meeting is appropriate where specified by procedures, or when multiple inspectors are performing the inspection. Even unannounced inspections normally begin with an entrance meeting with the most senior NPP management available.

However, in some cases a formal entrance meeting might not be necessary or required, i.e. routine resident inspections. In those cases, for the inspector's personal safety, another inspector or licensee representatives (usually the MCR operator) are informed of where the inspector is going to be in the facility.

Where a formal entrance meeting is appropriate, the lead inspector schedules and leads the meeting with senior plant management and appropriate staff. The lead inspector chairs the meeting and addresses the following:

- Purpose, scope and approach for the inspection;
- Duration of the inspection and schedule of the exit meeting;
- Inspection procedures that will be used during the inspection;
- Activities to be observed;
- Records to be evaluated;
- Personnel to be interviewed;
- Licensee input on current issues related to the inspection areas;

- Plant activities that may impact the scope or approach of the inspection;
- Any other logistical information for the inspection;
- Address any questions from the licensee regarding the inspection.

3.2.2 Performing the inspection

To the maximum extent possible, the inspection adheres to the approved plan. This will ensure the original purpose and scope of the inspection are met and resources are effectively used. There may be instances when the inspector may want to deviate from the inspection plan and pull the string on an observation that, while outside the scope of the inspection, may have some impact on the safe operation of the NPP. Before significantly deviating from the inspection plan, the inspector normally discusses this with the lead inspector or supervisor.

3.2.2.1 Communications during the inspection

Communication is very important during any inspection. The inspector routinely discusses emerging findings with both the licensee and the management of the regulatory body to ensure there are no surprises at the conclusion of the inspection.

For team inspections, the lead inspector normally holds a daily team meeting to exchange observations from the inspection and focus on the inspection areas for the next day. It is important that the team meetings be succinct and focused.

3.2.2.2 Inspector requests for additional information

Regulatory inspectors may need to request additional information to support their inspection needs. The licensee is expected to respond to inspector questions in a timely manner while giving priority to maintaining the safety of the plant. It is important that all questions are answered with sufficient time for the inspector to assess the response and either close out the issue or prepare a discussion of the issue for the inspection exit meeting. If the inspector is not receiving the information, the team leader needs to raise the issue to the management of the regulatory body and/or authorized party management.

3.2.2.3 Discussion of observations with the licensee

Observations (gaps/issues/concerns/problems) are normally discussed with the licensee representative early in the inspection. It may be possible for the licensee to provide additional information to either demonstrate compliance or implement corrective actions before the end of the inspection. The inspector needs to consider whether to immediately notify the licensee of potential safety significant issues that require urgent attention.

3.3 EVALUATION PHASE OF THE INSPECTION

During an inspection or walkdown, the inspector may identify one or more observations (gaps/issues/concerns/problems) which must be evaluated to determine if the issue is a potentially safety significant concern. For each observation, the inspector needs to determine:

- Is there an immediate threat to public health and safety?
- Is there a need for immediate regulatory action, including enforcement?
- Were there violations of laws, regulations, standards, procedures, or requirements?
- What is the adequacy of the licensee's determination of the extent of condition?
- What is the adequacy of the licensee's determination of the extent of cause(s)?
- What (if any) were the safety significance and safety consequences relating to the observations?
- How is the facility being operated within the regulations and license conditions while this condition exists?

- Has the concern been entered into the corrective action program?
- How is the safety of the facility and the public being maintained?
- When will the concern be corrected?

During the initial evaluation of the observations (gaps/issues/concerns/problems), the inspector must be aware of information that may affect possible regulatory response(s), including enforcement. The types of information may include, but are not limited to:

- How was the issue identified? (licensee, self-revealing, inspector);
- Is there evidence of wilful noncompliance?
- Is this a repeated issue?

(The lists above are not intended to be an exhaustive list of questions. They are a sample of the types of questions the inspector may ask the licensee.)

Regulatory inspection programmes normally provide guidance for the inspectors to evaluate observations and findings in accordance with their regulatory framework. Table 1 provides an initial screening tool for the inspector to quickly evaluating whether an observation requires additional assessment. This table is provided as an example and is not intended to replace any formal guidance provided in the regulatory body's inspection procedures.

TABLE 1. OBSERVATION WORKSHEET

Observation Worksheet				
Description of Observation:				
	Question	**Yes**	**No**	**Inspector justification and additional comments**
1	Does it involve a potential noncompliance with regulations, license conditions and/or a radiological or industrial safety issue?	Potential finding. Go to question 2.	No finding. However, it may be appropriate to notify the licensee of the observation. Go to question 2.	
2	Does the inspector think there is an **immediate** threat to public health and safety?	Potential finding. Notify facility and regulatory management. Go to question 3.	Potential finding. Go to question 3.	
3	Is there a noncompliance with regulations, license conditions and/or a radiological or industrial safety issue?	Finding. Discuss status of plant operability with the operators. Go to question 4	No finding. However, it may be appropriate to notify the licensee of the observation. Go to question 4.	
4	Is the licensee taking appropriate corrective actions?	Go to question 5.	Notify facility and regulatory management. Go to question 5.	
5	Is **immediate** enforcement action required to re-establish compliance with the regulations or license conditions (e.g., order or modification to the license)?	Apply enforcement as soon as practicable and appropriate within the regulatory and legal framework. Go to question 6.	Go to question 6.	
6	Is other enforcement action appropriate in accordance with the regulatory body enforcement policy?	Recommend enforcement action to regulatory body management. Go to question 7.	Document finding according to regulatory body inspection practice. Go to question 7.	
7	Are there any other considerations, i.e., potential generic safety issues, media interest or political interest?	Yes. Notify management.	No.	

Block 1:
If the inspector believes the observation is related to a regulated area, then the inspector will continue the screening process using the worksheet. If the observation is outside of the regulatory body's authority, the inspector may notify the licensee in order for them to evaluate the observation and take whatever action is appropriate. The notification may be as simple as a telephone call to the main control room or an email.

Examples of a Yes in Block 1:
- Missed sign off;
- Loss of control of combustible material;
- Mispositioned valve on a safety injection system.

Examples of a No in Block 1:
- Leaking plumbing fixtures;
- Paint chips on non-safety related piping;
- Graffiti inside the protected area of the plant.

Each regulatory body will make its own decision on what is within its authority and what is beyond that authority according to its legal framework.

Block 2:
If the inspector believes there is an **immediate** threat to public health and safety, then the inspector must immediately notify the management of the licensee and the regulatory body. While the inspector may not have all the facts, it is prudent for the inspector to inform the management of both organizations as soon as possible. If upon further evaluation, the licensee and/or the regulatory body determine that there is not an immediate concern, then the inspector will continue the screening process using the worksheet.

Examples of a Yes in Block 2:
- Water level in the ultimate heat sink (such as a lake) is below the usual level and appears to be going down rapidly;
- Pump discharge valves on both trains of the safety injection system are closed (mispositioned valves).

Example of a No in Block 2:
- In preparation for a refuelling outage, scaffolding is being built in all the emergency alternating current power sources rooms (e.g., emergency diesel generator rooms). Note that while this is a safety concern, it is not an **immediate** threat to public health and safety.

The regulatory body's inspector training programme will provide its own examples and describe the inspector's course of action.

Block 3:
The inspector may need to gather additional information to determine if there is a noncompliance with regulations, license conditions, and/or radiological or industrial safety issue. This may require additional plant inspections, record reviews, or interviews. When the inspector has sufficient information to make the decision, then the observation will become a finding, or the inspector will determine it is outside of the regulatory body's authority.

Examples of a Yes in Block 3:
- Reactor power level is above that allowed by the license;
- While painting is occurring in the safety related battery rooms, drop cloths are laying on the batteries to prevent paint and other foreign material from landing on the batteries. The answer is Yes because

(i) the batteries may overheat and not be capable of performing their safety function, (ii) the drop cloths may be a new fire hazard in the room, and (iii) the drop cloths may allow electrical shorting between the individual battery cells.

Examples of a No in Block 3:

- A pump discharge valve on a safety injection system is closed. The answer is No because in service testing of the system requires the valve to be closed during the test;
- A plant security system (e.g., microwave intrusion detection) is out of service. The answer is No because the licensee has implemented compensatory measures as allowed by the license.

Block 4:
Once the licensee is aware of the finding, the inspector will determine if the actions taken in response to the concern focus on safety, follow the facility's procedures, and have the resources needed to resolve the concern consistent with the additional risk related to the issue.

If the inspector does not believe the corrective actions taken, or proposed to be taken, are appropriate, then the inspector must immediately notify the management of the licensee and the regulatory body. The inspector must have sufficient facts to support the belief that the corrective actions are not appropriate. If the inspector determines that the corrective actions are appropriate, then the inspector will continue the screening process using the worksheet.

Example of a Yes in Block 4:

- After being notified by the inspector about a mispositioned valve on a safety injection system, the licensee immediately declares the system inoperable and enters into the appropriate license condition actions. In this example, the licensee is taking appropriate corrective actions.

Examples of a No in Block 4:

- The inspector identifies that the main control room operators' overtime limits routinely exceed regulatory requirements. No evaluation is performed by the licensee, even after being notified by the inspector;
- The inspector identifies scaffolding erected over safety related equipment without any seismic qualification tags. The licensee places seismic qualification tags on the scaffolding without performing an inspection or evaluation. The issue was not entered into the corrective action program;
- During a reactor start up, the inspector identifies that the minimum staffing requirements in the main control room are not being met. The licensee immediately adds a qualified operator to the crew. The operator had just returned from a 2-week absence. The start-up is not paused, and a shift brief is not performed. The shift brief could have ensured that the new member was aware of the status of the evolution.

Block 5:
If **immediate** enforcement action is needed to re-establish compliance, then the regulatory body will take enforcement action as soon as practicable. Depending on the level of authority granted to an individual inspector, this type of action may be performed by the inspector or by the regulatory body management. This may include actions such as:

- an order to immediately stop performing regulated activities;
- a new condition added to the license (e.g., additional control room operators required for certain evolutions, new lower maximum power limit),

If the inspector determines that immediate enforcement action is **not** needed, then the inspector will continue the screening process using the worksheet.

Example of a Yes in Block 5:

- Pump discharge valves on both trains of the safety injection system are closed and the licensee does not promptly take any action to correction the situation or to place the plant in a condition that does not require the affected safety injection systems.

Example of a No in Block 5:

- Pump discharge valves on both trains of the safety injection system are closed and the licensee takes immediate action to correct the situation and determine the cause of the event.

Block 6:

At this stage in the decision process worksheet, the inspector has determined that the observation is a finding (Block 3). Additionally, the licensee is taking, or planning to take, appropriate corrective action. This may have been due to self-identification of the issue by the licensee or to the regulatory body's involvement (Block 4). Immediate enforcement action is not required (Block 5). Even if immediate enforcement action is **not** required, other enforcement action, such as a warning, written directive, fine, modification of the license, etc. may be appropriate. The inspector will document the finding in an inspection report to support the basis for any enforcement action taken or not.

Example of a Yes in Block 6:

- Even though the licensee took immediate corrective actions, the mispositioned valve on both trains of a safety injection system is still a safety significant violation and the appropriate enforcement may need to be applied to prevent recurrence in the future.

Example of a No in Block 6:

- During an outage, the licensee performed an audit of the main control room operator's time sheets and identified that the operators' overtime limits were being exceed. The licensee revised the operator's schedule, entered the concern into the corrective action program, informed the regulatory body, and performed an evaluation to determine if there had been any events related to fatigue. Additionally, the licensee evaluated the time sheets from previous outages and determined this was an isolated event and not a repeating problem.

  In this example, regulatory enforcement action is not appropriate. Since the licensee identified the issue; took prompt, effective corrective action; did not find any events related to fatigue; and determined that it was an isolated incident; the regulatory body can simply document the finding in an inspection report and close the matter with no further action. (This assumes the regulatory body procedures allow this course of action.)

Block 7:
Sometimes, issues which do not require enforcement action and are simply documented in an inspection report may require additional regulatory body management attention. The following are provided as possible examples of issues which may or may not warrant additional regulatory body management attention.

Example of a Yes in Block 7:

- During a refuelling outage at a pressurized water reactor NPP, there is a small fire in the turbine building caused by welding activities. The fire is quickly extinguished, no personnel are harmed, no radiation is released, and no equipment is damaged. The local media reports that a fire occurred at the NPP. In this example, the media coverage may generate additional questions and concerns from the local community. The inspector would normally notify the regulatory body management.

Example of a No in Block 7:

- A postal delivery truck has a flat tire which blocks traffic on the public access road to the nuclear power plant for a short period of time. The facility's security force contacts the local community police for assistance. The local police respond and direct traffic while the postal truck is repaired. The flow of traffic is quickly restored. Activities at the NPP are not impacted by the event. In this example, since there is no obvious media or community interest, no further action is necessary.

3.4 REPORTING PHASE OF THE INSPECTION

There are two parts to the formal reporting phase of an inspection. The first is the presentation of the inspection results at an exit meeting with the licensee. Depending on the regulatory body's practices, these results may be subject to the inspector's supervisor's review or the results may be final. The second part is the documentation of the results in the regulatory body's official inspection report.

3.4.1 Exit meeting

The inspector(s) needs to thoroughly plan and prepare for the exit meeting. During the meeting the findings can be presented by one or multiple inspectors depending on the finding and the inspector's expertise. Throughout the inspection the inspectors routinely communicate the inspection results to the licensee to ensure there are no surprises at the exit meeting.

The planning and preparation for the exit meeting includes:

- Careful consideration of the overall message to the licensee based on the inspection results;
- Discussing the findings with the inspector's management before the exit meeting (e.g., are there potential violations and findings that have a high safety significance).

During the meeting the inspectors need to:

- Briefly restate the inspection scope;
- Present overall conclusions;
- Discuss any potential violations, including:
  - a description of the finding;
  - the requirement or license condition that was not met;
- Provide the licensee the opportunity to respond.

Throughout the meeting, the inspector also:

- Engages licensee management in the conversation so they clearly understand the results of the inspection;
- Maintains control of the meeting. If difficulties arise, the inspector may consider adjourning the meeting and discussing the matter with regulatory body management;
- Keep it short and simple. Get to the main points;
- Cites facts, observations, and examples.

3.4.2 Inspection report

The purposes of the inspection report are to:

- Record the results of all inspection activities relating to safety or of regulatory significance;
- Document and record an assessment of the licensee's activities in relation to safety;

- Record discussions held with licensee's staff, management and other concerned persons;
- Provide a basis for informing the licensee of the findings of the inspection and of any noncompliance with regulatory requirements, and to provide a record of any enforcement actions taken;
- Record any findings or conclusions reached by inspectors;
- Record any recommendations by inspectors for future actions by the licensee or the regulatory body and to record progress on recommendations from previous inspections;
- Inform other staff of the regulatory body of inspection results;
- Contribute to maintaining an organizational memory.

Inspectors must use a standard report format developed by their regulatory body for documenting the inspection. GSG-13 [2] provides detailed information on the content of the inspection report. The information in the inspection report should include, but is not limited to:

- Facility inspected and dates of the inspection;
- Purpose and scope of the inspection;
- Names of the inspectors;
- Findings identified during the inspection;
- Regulatory assessment of the findings;
- Enforcement actions taken, if any;
- Licensee's corrective actions.

3.5 INSPECTOR CONDUCT AND OBJECTIVITY

An inspector is a government employee and a representative of the regulatory body. An individual inspector may be the only contact a plant employee, contractor, vendor, local and regional government official, or member of the public has with the regulatory body. An inspector's conduct and objectivity are always being observed and evaluated. A single interaction an inspector has with an individual may determine their opinion of the entire regulatory body and inspection program. An inspector's behavior, both on duty and off duty, must demonstrate that the inspector is trustworthy, reliable, unbiased, and honorable.

3.5.1 Inspector conduct

It is imperative that inspectors conduct themselves in a professional manner. The authority vested in inspectors obliges them to conduct themselves at all time in a manner that inspires confidence in and respect for their competence and integrity. Inspectors must demonstrate, by their actions and demeanor, that as government employees they are committed to give the public full value of their services by putting in a full day. In addition, inspectors are to be aware that inappropriate behavior, both during and outside of working hours, can discredit both the individual and the regulatory body. For example, the inspector needs to:

- Avoid the appearance of loss of impartiality. The standards of conduct required by the regulatory body normally provide that inspectors take appropriate steps to avoid even an appearance of loss of impartiality in the performance of their official duties;
- Follow the letter and the intent of the regulatory body conflict of interest requirements in any interaction with the licensee. Control off hours activities so that their ability to perform assigned duties is not impaired during duty hours;
- Not misuse the position of a government employee/official.

3.5.2 Maintaining inspector objectivity

Objectivity is the extent to which the inspector implements the inspection programs, interfaces with the public and conducts both personal and work relationships in an unbiased manner. Inspectors need to be free from both partiality and antagonism toward a licensee or vendor, or the employees of a licensee or vendor.

The management of the regulatory body is responsible for overseeing inspectors in their interactions with authorized parties. Management needs to clearly communicate performance expectations to inspectors and evaluate feedback from authorized parties regarding inspection activities. Management needs to consider periodically visiting the site and discussing the inspector's objectivity with both the inspectors and the licensee.

Measures of objectivity include how well inspectors:

- Independently verify information from the licensee when appropriate;
- Adhere to regulatory positions and policies when discussing issues with the licensee or the inspector's management, avoiding personal interpretations and opinions;
- Maintain a professional relationship with the licensee using good interpersonal relationship skills;
- Provide an accurate and balanced account of licensee performance and plant conditions in communications with management through inspection reports, telephone calls, or other means;
- Focus on safety significant concerns, applying significance determination and enforcement guidance appropriately;
- Develop issues without biased interpretation of facts;
- Adequately support findings with facts.

4. PERFORMING INSPECTIONS

This section provides more detailed information to inspectors on what to look for during inspections of structures, systems and components of a nuclear power plant. To achieve this, Section 4 is divided into six areas:

- Section 4.1 provides guidance on plant inspections;

- Section 4.2 provides some guidance on observing maintenance and surveillance activities;

- Section 4.3 provides guidance on inspections of equipment at the component level;

- Section 4.4 provides guidance for the inspection of the main control room;

- Section 4.5 provides guidance for the inspection of the primary containment;

- Section 4.6 provides guidance for the inspection of activities during outages.

Many of these subsections refer to Inspection Guides (Annex) which contains questions the inspector may find helpful during inspections. The Guides and questions are not intended to replace the inspection procedures of the regulatory body nor should they be used as a comprehensive check list. These are supplementary tools for use during assessment of the licensee's activities.

4.1. PLANT INSPECTIONS

Plant inspections are an integral part of the inspection program. Direct observation of operations and work activities is an important tool for the inspector to independently verify licensee performance and provide an opportunity to assess the plant's material condition. Additionally, plant inspections provide an opportunity to identify concerns which may not be apparent if the inspector relies solely on desk top reviews of maintenance or test procedures which were completed sometime in the past.

There are several opportunities for the inspector to perform plant inspections. For example, inspectors may routinely tour containment during an outage. Additionally, an inspector can accompany operators on routine plant rounds or accompany a system engineer on a system walkdown and thereby obtain a sense of how concerns are identified and resolved.

Inspectors need to consider periodically touring the facility to identify changes in the plant which may signify potential degradations in plant or operating conditions. Performing plant rounds and conducting general area inspections provide the inspector with an opportunity to maintain an awareness of overall plant status and activities. These inspections use good engineering judgement, internationally accepted good practices, and administrative requirements such as housekeeping standards as the evaluation criteria. If the inspector identifies observations which require additional evaluation, the inspector will use the appropriate, specific procedure(s) to continue the assessment of the concern(s). Some examples of observations identified during general area inspections or plant rounds which may require additional follow up are identified below.

- There are new danger or information tags attached to individual components of the system since the inspector's last tour of the area;
- There is new scaffolding in the vicinity of the safety related pumps, pipes, or valves since the inspector's last tour of the area;
- Some valve positions on the safety injection systems are not in their usual position for the current status of the plant.

Plant inspections may be conducted on general areas of the plant (i.e. reactor building), specific areas (i.e., spent fuel pool), a system or train (i.e., safety injection system), or the component level (i.e., reactor coolant system pressure relief valve). While these inspections may have different focus and may use different methods, the overall inspection objectives remain the same:

- Is the area, component, train, or system capable of performing its safety related function?
- Is the licensee identifying and resolving problems consistent with their importance to safety?
- Do the licensee's activities in the plant and condition of the SSCs demonstrate that the plant procedures are followed, and license conditions and regulatory requirements are met?

4.1.1 Before you go

4.1.1.1 Be prepared

Be prepared to perform your inspection. Have a specific purpose for your activity (e.g., plant tour, control room walkdowns, observing maintenance activities, operator rounds, etc.). During your inspection, there may be instances when you may deviate from the original inspection plan and decide to pull the string on an observation. While the observation may be outside the scope of the original inspection, it may have some impact on the safe operation of the NPP. Remain flexible enough to identify observations that are unrelated to your initial task. Be prepared to follow up on observations consistent with their importance to safety.

If you are planning to observe work in progress (e.g., maintenance, surveillance, testing) then find out which activities the licensee has scheduled and make them part of your plan. Give the licensee as much notice as possible on the activities you would like to observe. Review the work package and be prepared. There is additional information regarding observing maintenance and surveillance activities in Section 4.2 below.

4.1.1.2 Tools of the trade

Take notes during your walk downs and inspections. Always have paper and a pen and a flashlight. Depending on the inspection you are performing, other items may be helpful, such as:

- Note book, clipboard, drawings/diagrams;
- Voice recorder;
- Portable computers, tablets;
- Laser pointer;
- Camera;
- Radiation meters;
- Pyrometer/thermal imaging device;
- Inspection mirror.

The inspector needs to be aware of the licensee's requirements when using electronic equipment during an inspection.

When you make notes, take the time to collect your thoughts and write clearly. Your observations and notes may identify concerns that have a bearing on safety or security. Your observations and notes may warrant continued inspection, screening, evaluation, or further regulatory action.

4.1.1.3 Know the licensee's rules for plant access

Before you enter the operating areas of the facility, review the licensee's requirements and procedures. Remember that these requirements apply to inspectors, too. Some important examples are listed below.

- Applicable radiation work permits (RWPs). Ensure you are properly wearing the necessary dosimetry, if applicable;
- Occupational/industrial safety regulations. You are responsible for your own safety. Use your PPE such as eye, ear, and foot protection. Remain aware of personal safety hazards (trip/fall hazards, confined spaces; temperature, fire safety, etc.) at all times;
- Foreign material exclusion (FME) requirements. Don't' become part of the problem. Use hard hats with straps, badges secured with extra lanyards, safety glasses with retainers and neck cords, etc;
- Security and Fire Protection requirements.

Use all of your senses during walkdowns and inspections. Beyond using your sight, remain sensitive to sounds, smells, temperature, vibrations, etc. Learn what is **normal** so you can identify an abnormal condition.

- Only touch doorknobs and handrails;
- Avoid inadvertent equipment actuation and do not operate plant equipment;
- Do not test equipment or challenge security devices;
- If you are unsure if a door or area should be locked (or unlocked), then contact the control room. Leave it the way you found it;
- If you want to observe the operation of a piece of equipment, make the appropriate arrangements with the licensee.

4.1.2 Performing plant inspections

As previously noted, a plant inspection may be for a specific area of the plant, for a system (or train), or may be at the component level. In all cases, the inspector needs to:

- Become familiar with the entire station;
- Maintain a questioning attitude. Ask Why frequently;
- Follow the plan while remaining flexible enough to follow up other concerns you identify;
- Use inspection procedures, but don't get tunnel vision. Use check lists as guides;
- Pull the string if something doesn't seem completely correct;
- Understand that, just because it has **always been that way** does not mean there is a sound technical basis;
- Vary inspection route; avoid **regular** tour paths;
- Know what is normal in order to identify abnormal conditions. This applies to the behavior of the staff as well;
- Respect the time of the licensee staff and do not interfere with station operations unless necessary;
- Keep a list of items to be followed up later. Use this list during subsequent walkdowns and inspections;
- Address emergency issues immediately by notifying the Control Room.

Refer to the attached Inspection Guides for additional questions you may consider during your walkdowns and inspections.

Direct observation of the plant's spaces gives the inspector another opportunity to independently assess the condition of SSCs. Plant observations of the SSCs, housekeeping, and the general material condition of the plant can provide an indication of how tolerant the licensee is of degraded conditions.

Below is a general list of items to look for during an area plant inspection. This is not a comprehensive list and the questions are not intended to be used as a checklist.

- Is there any indication that the SSCs may not be capable of performing their safety related function?
- If one train of a system is inoperable or degraded, what is the status of the other train?
- Does the as built configuration match the analysed design and the drawings?
- Are there any temporary changes & temporary modification?
- Is there any mechanism in place for tracking of temporary modifications?
- Is the licensee relying on compensatory measures, temporary modifications, or operator work arounds to compensate for a degraded condition? (e.g., jumpers to bypass nuisance alarms.)
- Does the condition of the area demonstrate that the management and staff are sensitive to degraded plant conditions? For example, are water and oil leaks or boric acid build up tolerated? Corrosion, large number of deficiency tags, unnecessary storage of equipment or material, etc.?
- Are deficiencies promptly identified, evaluated, and placed in the corrective action program?
- Is the schedule for correcting deficiencies consistent with the contribution to risk and impact on the plant's safe operation?
- Does the activity in the area and condition of the area demonstrate that the staff follows the station's procedures and controls? Some important examples are:

1.
    - Radiation protection;
    - Security;
    - Foreign Material Exclusion (FME);
    - Personal Protective Equipment (PPE);
    - Fire Protection;

- o Scaffolding Permits.

Programs such as radiation protection, security, and fire protection are specialized areas. Inspections of those programs are usually assigned to inspectors with specialized training. If you identify concerns in these areas, request their assistance for determining the significance of the issue. Always make sure the licensee is aware of your concerns.

Areas of the NPP such as the main control room and containment require more specific attention during inspections. Additional questions which are focused on these areas are found in below in Section 4.3, Main Control Room, and Section 4.4, Containment.

Attached to this handbook are Guides which contain questions related to housekeeping, FME, and scaffolding. The Guides and questions presented above are not intended to replace your inspection procedures or plans or to be used as a comprehensive check list. These are more tools to use during your assessment of the licensee's activities.

4.1.3 Completing the plant inspection

As stated in section 2.2 of this handbook, the primary purpose of regulatory inspections is to independently provide a high level of assurance that activities performed by the authorized body are in compliance with the regulatory requirements and with the conditions specified in the authorization or license. The Regulatory Body performs inspections of a sample of the authorized body's activities

An observation of a test or maintenance activity, accompanying a plant operator on rounds, or performing a general area plant inspection are all parts of the regulatory body overall assessment of the licensee's compliance with regulatory requirements. The inspector's evaluation of individual activities is used a part of the sample of licensee activities.

When the plant inspection is completed, the inspector continues with evaluating the observations and findings in accordance with the regulatory bodys inspection program. Below are some additional thoughts to consider during your assessment of the observations and findings.

- Ensure concerns you have identified are provided to the licensee. The licensee may have information that is relevant to your assessment;
- Follow up on safety significant concerns to verify these concerns have been appropriately evaluated by the licensee's corrective action program. Challenge the operational or engineering uncertainties;
- If you are not sure of the safety significance or priority of the concern, then contact a peer, a senior inspector, or your supervisor. Additional study or research may be required to determine the safety significance of the concern;
- Assess the licensee's evaluation as part of your follow up. Just because it has **always been that way** does not mean there is a sound technical basis for the action or design.

4.2 OBSERVING MAINTENANCE AND SURVEILLANCE ACTIVITIES

If you are planning to observe work in progress (e.g., maintenance, surveillance, testing) find out which activities the licensee has scheduled that are relevant to your inspection and make them part of your inspection plan. Let the licensee know which activities you would like to observe with as much notice as possible.

Remember to use a graded approach when selecting work activities to observe, since some components have a greater contribution to risk than others. Also, remember that it is not always possible or necessary to observe every aspect of the activity. Regulatory inspection samples the licensee's activities and is not intended to be comprehensive. The licensee is responsible for the safe operation and maintenance of the facility.

Prepare yourself by reviewing the following documents:

- Work order and package;
- System descriptions, drawings, and applicable procedures;
- Vendor manuals and vendor recommendations (including justification if recommendations are not followed);
- Technical Specifications and license conditions;
- Previous inspections, maintenance, and surveillance results;
- Radiation Work Permit (RWP);
- Corrective action programme entries for the SSC;
- Final Safety Analysis Report (FSAR);
- Operating Experience Feedback (OEF).

Before the work starts, the inspector needs to consider whether:

- The licensee has verified compensatory measures (e.g. redundant trains) are in place to ensure plant conditions support isolating the equipment and performing the work;
- The licensee has contingency plans to manage risk while the SSC is out of service (OOS);
- The licensee has confirmed which critical components and critical parameters are to be measured and/or tested?
- Observe pre-job briefing;
- If a rehearsal of the work is performed, observe mock up, and the entire walk through of the activity;
- If you want or need to see something specific, let the licensee know as soon as possible. If space is restricted or the environment (radiation, temperature) limits access to the area, determine if a more limited view will satisfy the inspection. (Maybe a video camera will be sufficient.);
- Has the licensee checked that sufficient spare parts are available prior to the work being initiated?
- Has the licensee evaluated maintenance across multiple components for potential common cause failure?
- How has the licensee ensured that equipment has been isolated prior to maintenance?
- What are the backup and back out plans if the activity must be stopped before completion?
- How will the licensee prevent foreign material from entering a system?
- Is the current work order or package being used?
- Check the worker is qualified for job? (Field qualification along with radiation protection training etc.)
- Have appropriate radiation protection measures been taken?
- Has a radiation protection plan (if required) has been established and well understood?
- Is the test equipment and instrumentation calibrated?

During the activity:

- Introduce yourself to the workers and explain that you will be observing the activity;
- Be sure you do NOT approve or endorse the licensee's work activity;
- Stay out of the way. Take notes and only ask questions when it will not interfere with the activity. However, don't be afraid to ask a question if something doesn't make sense;
- Have the work procedures in hand;
- Verify whether the work permit has been approved by MCR personnel;
- Observe how the licensee confirmed they are on the correct equipment (unit or train)?

- Pay special attention to coordination and communication between operations and the maintenance activity;
- Verify whether the work team are adhering to station procedures:

    - o Following the approved maintenance procedures and accepted industry practices;
    - o Using appropriate PPE and following personal safety requirements;
    - o Following the appropriate RWP and using radiation monitoring equipment correctly (e.g., in neutron area used neutron thermoluminescent dosimeter or electronic personal dosimeter, etc.);
    - o Following the principles of contamination control, and waste minimization, and as low as reasonably achievable (ALARA);
    - o Adhering to FME controls and good housekeeping practices;
    - o Adhering to the licensee's communication expectations.

- Does the licensee document the as found conditions?
- Are problems encountered during the activity entered into the corrective action program?
- Does the licensee have all the tools, spare parts, and consumable items (e.g., gaskets) at the job site?
- Is there any validation/verification of the work being performed (peer check, quality control hold points)?
- If a part is being replaced, is the replacement part identical (alloy, shape, orientation, and manufacturer)? If not, has the replacement part been evaluated and approved?

Post maintenance testing (PMT) and return to service

The licensee is normally required to perform PMT to determine if the SSC is ready to be returned to service and is capable of performing its safety related function. The inspector needs to consider whether to:

- Observe the PMT. If direct observation is not possible, then evaluate the results of the PMT;
- Compare the PMT acceptance criteria to the license conditions and technical specifications requirements to determine if the equipment is capable of performing its safety related function;
- Determine if the surveillance test acceptance criteria are supported by calculations or other engineering documents;
- Determine whether the PMT validates that the SSC will operate as designed? If some performance degradation is identified, ask how the licensee is going to evaluate it and whether the SSC is still considered operable.

4.3. INSPECTING EQUIPMENT AND COMPONENTS

Plant systems are a complex set of components designed to work together to perform a single task or multiple tasks. An inspection at the component level is an opportunity for a more detailed assessment of the equipment. Since components are usually only examined as part of a system of train inspection, some additional guidance may be useful when evaluating the individual parts.

While inspecting at the component level, there are some fundamental principles which are always applicable:

- Is the component capable of performing its safety related function?
- Does the condition of the component demonstrate that staff follows the station's procedures and management's expectations?
- Is the licensee identifying and resolving problems consistent with their importance to safety?

In the Annex of this handbook are Guides which may be helpful to determine if the component is capable of supporting the system or train in performing its safety related function. The Guides and questions are not intended to replace your inspection procedures or plans or to be used as a comprehensive check list. The Guides are one more tool to use during your assessment of the licensee's activities.

During plant inspection, the inspector considers the following:

- Is the installed component consistent with the piping and instrument diagram?
- Will equipment and instrumentation elevations support the design function?
- Has adequate sloping of piping and instrument tubing been provided?
- Are required equipment protection barriers (such as walls) and systems (such as freeze protection) in place and intact?
- Does the location of the equipment make it susceptible to flooding, fire, high energy line breaks (HELB), or other environmental concerns?
- Has adequate physical separation/electrical isolation been provided?
- Are there any non-seismic structures or components surrounding the components which require evaluation for impact upon the selected component?
- Does the location of equipment facilitate manual operator action, if required?
- Are baseplates, hangers, supports and struts installed properly?
- Are there indications of degradations of equipment?
- Are the motor operated valve operators and check valves (particularly lift check valves) installed in the orientation required by the manufacturer?

4.3.1 Individual components

Plant systems are a complex set of components designed to work together to safely perform a task. Each component must perform its intended function during normal and emergency conditions. Each type of component has unique features and the inspector must have some familiarity with the equipment to able to distinguish between what is normal and what is an abnormal condition. While drips, leaks, and missing labels are obvious deficiencies the licensee must address, the individual components have a variety of design elements which need individual attention to determine if it is capable of performing its safety function.

Below are some of the components you will be assessing during your system or train walkdown/inspection. There are more detailed Guides in the Annex of this handbook which may be helpful during your inspection.

4.3.1.1 Gauges

System and equipment parameters such as temperatures, pressures, flow, level, etc., are provided to allow the operators to safely operate plant systems. The gauges must have the range, accuracy, and graduations that are consistent with the requirements of the procedures. The gauge must be displayed in a useful fashion, must be in good working order, and must be reliable. Figure 2 is an example of a combination temperature and pressure gauge. The Guides in the Annex of this handbook provide additional questions which may be helpful during your inspection

FIG. 2. COMBINED TEMPERATURE AND PRESSURE GAUGE WITH MULTIPLE SCALES

4.3.1.2 Valves

Valves are an essential part of every system. Their most basic function is to stop or control a fluid (vapor or liquid) in a pipe. Some valves are designed to perform multiple functions and others have only one.

Most valves share some common features: seat and disk, body and bonnet, stem and operator, and packing material. Figure 3 is a simplified illustration of some common features of manually operated valves.

- The stationary **seat** and the movable **disk** operate together to stop or throttle system flow;
- The valve body is a pressure boundary which contains the seat. It is welded or bolted to the system piping;
- The bonnet is a pressure boundary which is welded or bolted to the valve body. It contains the packing and supports the stem;
- The stem is attached to the disk and positions the disk to stop or control flow. The stem may be moved by an attached handwheel or by an electric, hydraulic, pneumatic, or solenoid actuator;
- The packing is a flexible material that surrounds the stem and prevents fluid leakage where the stem passes through the bonnet.

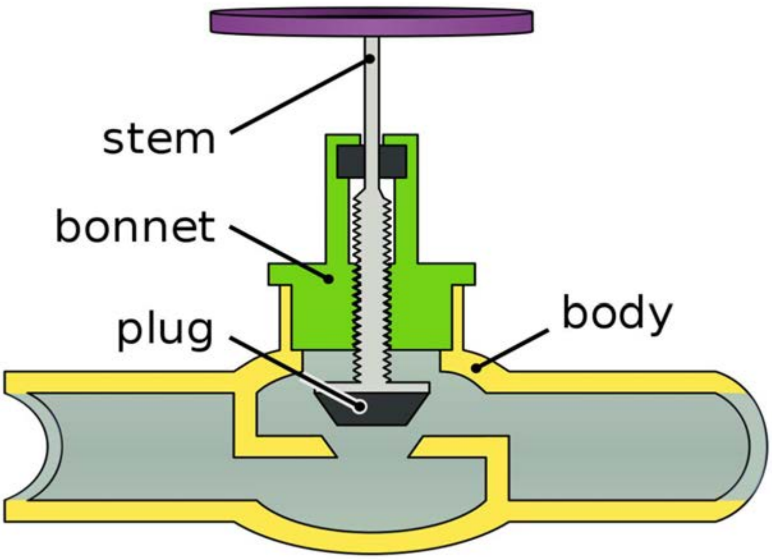

FIG.3. COMMON FEATURES OF MANUALLY OPERATED VALVES

Many valves have external markings (sometimes called bridgewall markings) on the valve body which identify the direction of flow through the valve. Figure 4 illustrates a bridgewall marking. The arrow on the valve body indicates the direction of flow through the valve.

FIG.4. BRIDGEWALL MARKING ON A VALVE

Valves are positioned using a variety of methods including: manual, motor operated valves (MOV), air operated valves (AOV), hydraulic operated, and solenoid operated. The licensee will have detailed programs for the maintenance and testing of the valve operators, especially MOVs.

As stated above, some valves are designed to perform multiple functions and while others have only one. Listed below are examples of some different valve designs and a brief explanation of their functions. The examples listed below are not intended to be an exhaustive list. The Guides in the Annex of this handbook provide additional questions which may be helpful during your inspection.

- Gate valves
  - Figure 5 is a simplified illustration of a manually operated gate valve;
  - Used for isolation;
  - Fully open or fully closed. When fully closed, the gate (disk) is forced against the seat giving a tight seal. When fully open, the gate is out of the flow path;
  - Partially open position causes increased wear on the valve disk.

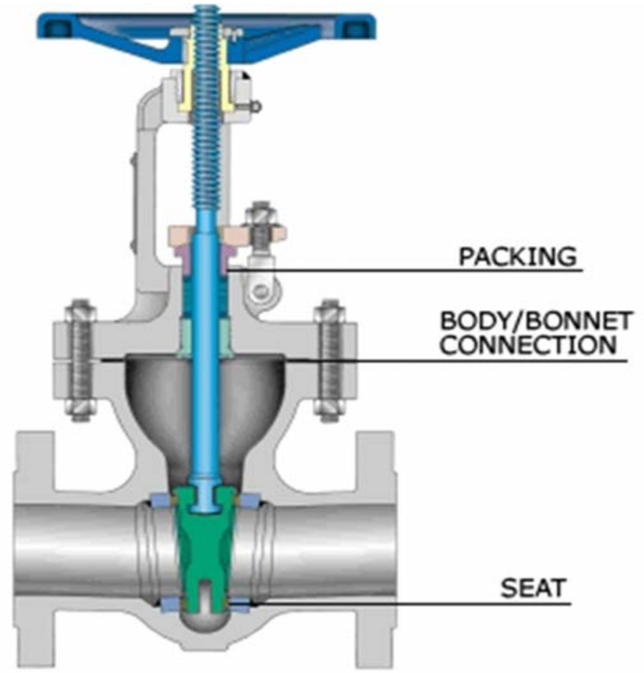

FIG.5. GATE VALVE

- Globe valves
  - Figure 6 is a simplified illustration of a globe valve;
  - Primarily used to regulate or throttle flow. Can be used for isolation;
  - When used to regulate flow, the seat and disk are not damaged as readily as when a gate valve is used to regulate flow;
  - Have a rounded disk and tapered seat;
  - These types of valves come in a variety of configurations including:
    - Angle globe valve which is designed to serve both as an isolation and throttle valve and as a 90-degree piping elbow;
    - Needle glove valve which has a sharp pointed conical disk and matching seat for fine flow control in small diameter piping.
  - Figure 7 is a simplified illustration of a manually operated needle globe valve;
  - Used for fine flow control in small diameter pipe;
  - Has a sharp pointed conical disk and matching seat.

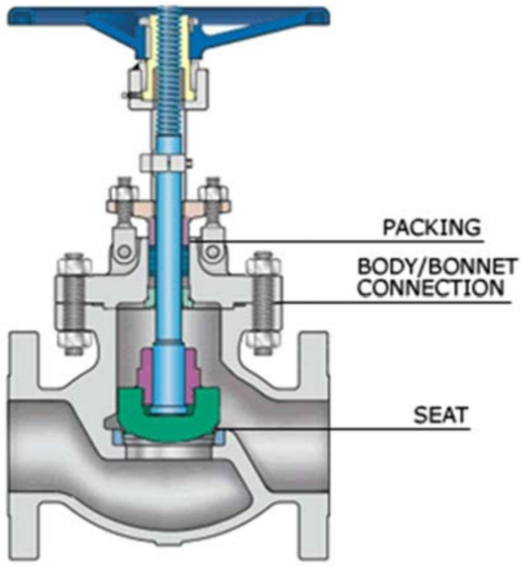

FIG.6. GLOBE VALVE

- Butterfly valves
  - Figure 7 is a simplified illustration of a manually operated butterfly valve;
  - Used for isolation. Unable to seal tightly if there are high pressures differences across the valve disk;
  - One quarter turn of the disk to position from fully open to fully closed. (90-degree operation);
  - Light weight;
  - Low pressure drop when fully open;
  - Commonly used in low pressure, low flow systems with large diameter piping;
  - Poor flow regulation (throttling) characteristics.

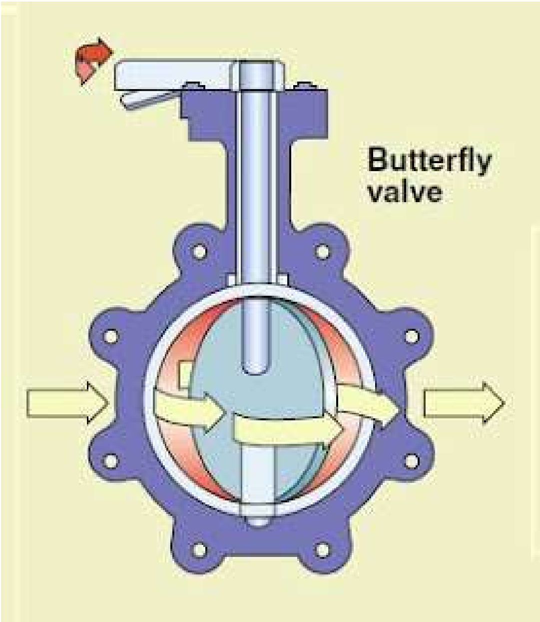

FIG.7. BUTTERFLY VALVE

- Ball valves
  - o Figure 8 is a simplified illustration of a manually operated ball valve and Figure 9 is a detailed figure of the ball valve internal components;
  - o Used for isolation. Provides a tight seal;
  - o One quarter turn of the ball (disk) to position from fully open to fully closed. (90-degree operation);
  - o Commonly used in high pressure systems;
  - o Poor flow regulation (throttling) characteristics.

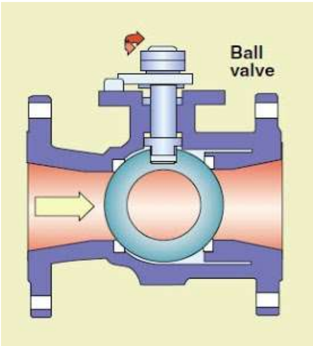

FIG.8. BALL VALVE

FIG.9. BALL VALVE INTERNAL COMPONENTS

- Check valves
  - o Figure 10 is a simplified illustration of a swing check valve;
  - o Allows flow only in one direction;
  - o Little resistance to flow when open;
  - o Automatically closes when system flow reverses;
  - o Swing check valves are the most common design used in NPPs;
  - o A swing check valve is not used on for isolation;
  - o Many different designs and configurations such as lift check valves and stop check valves.

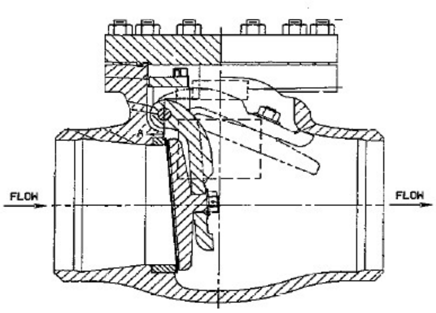

FIG.10. SWING CHECK VALVE

Relief valves and safety valves

- o Figure 11, is a simplified illustration of a safety relief valve;
- o Prevent system pressure from exceeding a specific value and prevents equipment damage due to high pressure conditions;
- o A relief valve gradually opens as pressure exceeds a setpoint.
  - As pressure drops below the setpoint, the relief valve gradually closes;
- o A safety valve rapidly opens (pops open) when pressure exceeds the setpoint. It remains fully open until pressure drops below a specific value (the reset pressure).
  - The difference between the actuating pressure setpoint and reset pressure is called blowdown;

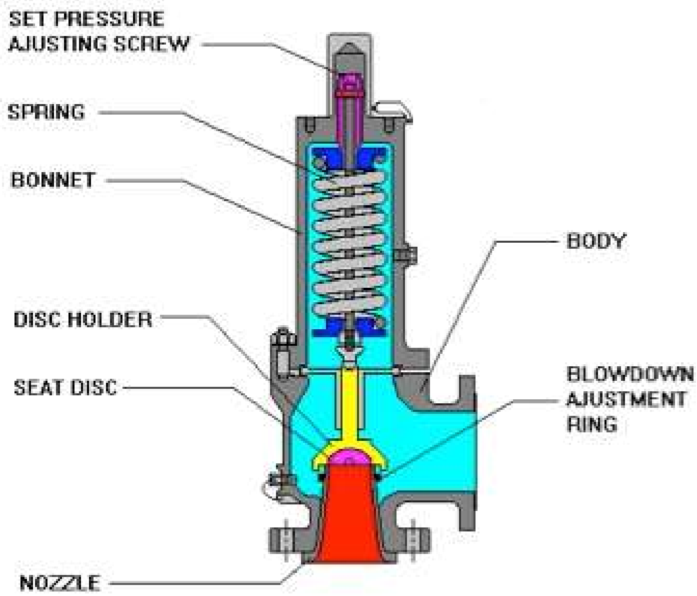

FIG.11. SAFETY RELIEV VALVE

4.3.1.3 Motors

Motors convert electrical energy into mechanical rotational energy. Motors operate many types of equipment including pumps, fans, compressors, and valves. Figure 12 is a simplified illustration of a motor coupled with a centrifugal pump. Most are AC powered, while a few which are needed for abnormal conditions operate on DC power. Motors have temperature and vibration detection systems, cooling and lubricating systems, bearings, and other support systems which must operate correctly for the motors to perform their intended function. The licensee will have detailed programs for the maintenance and testing of motors. The Guides in the Annex of this handbook provide additional questions which may be helpful during your inspection.

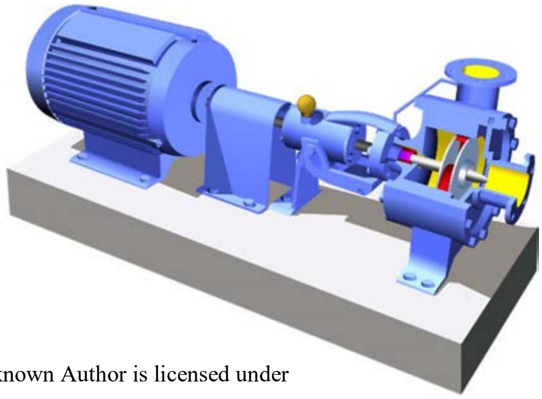

FIG.12. MOTOR COUPLED WITH A CENTRIFUGAL PUMP

4.3.1.4 Pumps

A pump is a mechanical device used to move a fluid (liquid or gas). Figure 13 is a simplified illustration of a centrifugal pump which shows how fluid moves through the pump. A pump does work on the fluid, thereby giving it energy to move. The driver mechanism for the pump is usually an electric motor, but sometimes it is a steam turbine or a diesel engine. Pumps have temperature and vibration detection systems, cooling and lubricating systems, bearings, and other types of support systems which must operate correctly for the pump to perform its intended function. The licensee will have detailed programs for the maintenance and testing of pumps. The Guides in the Annex of this handbook provide additional questions which may be helpful during your inspection.

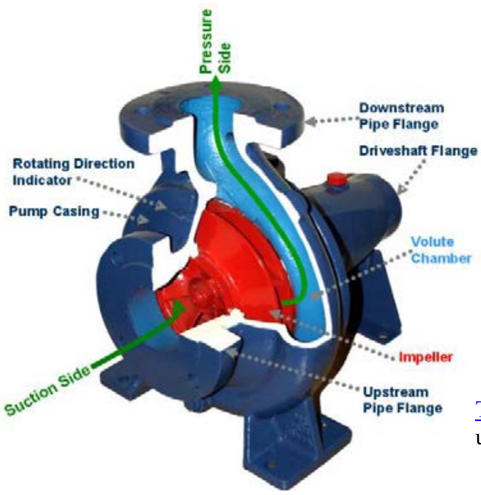

FIG.13. CENTRIFUGAL PUMP

4.3.1.5 Oil reservoirs – oil bubblers – bottle oiler

The bearings on motors and pumps require lubrication. The lubrication reduces friction, dissipates heat, and inhibits corrosion on the ball bearings and raceways. The lubricant is usually a type of grease or oil. Figure 14 is an example of a common method for pump bearing oil lubrication: a constant level oiler. While this type of delivery systems appears simple, there are multiple adjustments required for the device to operate correctly and to maintain adequate lubrication in the bearing housing. The Guides in the Annex of this handbook provide additional questions which may be helpful during your inspection of constant oil level lubrication.

FIG.14. CONSTANT LEVEL OILER

4.3.1.6 Electrical components

Beyond motors and MOVs, plant systems contain multiple electrical devices which must perform their intended functions during normal and emergency conditions. Examples include circuit breakers, motor control centers (MCCs), inverters, relays, cables, and batteries. The licensee will have detailed programs for the maintenance and testing for most of the individual electrical devices. The Guides in the Annex of this handbook provide additional questions which may be helpful during your inspection.

4.3.1.7 Piping supports

Plant systems are a complex set of components designed to work together to safely perform a task. From the fasteners which mechanically join components, to pipe supports which carry the weight of the pipe and transfer it to the surrounding structures, to the snubbers which restrain and protect the piping system during abnormal conditions, the motors and pumps, valves, piping, and instruments must be properly joined and supported to ensure system will perform their intended purposes. Figure 15 shows several examples of piping supports commonly found in a commercial nuclear power plant.

The licensee will have detailed programs for the maintenance and testing for most of the individual fasteners, supports, and snubbers. The Guides in the Annex of this handbook provide additional questions which may be helpful during your inspection.

FIG.15. PIPING SUPPORTS

4.4 MAIN CONTROL ROOM

The main control room (MCR) is the centre of plant operations. It is equipped with the displays, instruments, alarms, controls, and procedures needed to safety operate the plant and, if needed, to mitigate the consequences of abnormal events. The control room is staffed by trained and qualified personnel who monitor and control key plant activities including start up and shut down, power changes, refuelling, maintenance and testing, and transient situations. As an onsite inspector, you need to be familiar enough with the activities in the MCR and with the control panels to identify unusual or abnormal conditions. Inspections of the MCR help the inspector maintain an awareness of overall plant status and activities.

If you are planning to observe activities in the MCR, find out what activities or tests are scheduled. If there is a specific activity or test you would like to observe, you may need to inform the licensee in advance in order to discuss how you can perform your inspection and not interfere with the operators or supervisors. Before the activity, read the procedures, identify which control panel indications you want to see, and confirm where you can observe without interfering. You must be able to perform your inspection while staying out of the way.

Performing a control panel inspection or observing a routine shift turnover will provide insight into the licensee's day to day operation of the station, even if you are not observing a specific activity or test.

Similar to the concept of not always using the **regular** tour path, the inspectors need to perform unannounced, off hours (back shift, holidays, and weekends) walkdowns/inspections of the MCR. This helps you become familiar with the licensee's operating habits during periods when much of the senior NPP management is not on site. Additionally, this may help you determine if the staff is consistently following procedures and management's expectations regardless of the time of day.

While the inspector may have the legal authority to observe any activity related to the safe operation of the plant, inspectors must always follow the licensee's procedures for access to the MCR. It is important to respect the licensee's responsibility for the safe operation of the NPP, and inspectors need to maintain a professional relationship with the licensee.

While your inspection programme may not require a complete, daily MCR walk down, it is a good practice to visit the MCR every day you are on site. If the plant has multiple control rooms, be sure to go in to each of the units on a weekly basis.

The sections below identify several areas which may help you determine if all activities performed by the licensee are in compliance with the regulatory requirements and with the conditions specified in the authorization or license. These are not intended to replace your inspection procedures or plans and are not intended to be exhaustive. They are presented as an aid for your assessment.

4.4.1 Main control room access

Before you enter the MCR, especially for the first time, review the licensee's requirements and procedures. Remember the requirements apply to you.

Access to the MCR requires authorization and permission to enter. Permission is usually granted by the control room supervisor.

A licensee may prohibit wearing certain items such as hardhats and safety glasses in the MCR. The concern is a hardhat or pair of safety glasses may fall on a control panel and may start or stop equipment. This may create a plant transient or injury plant staff members or damage equipment. Outside of the MCR there may be a shelf or locker to store your safety equipment before you enter.

4.4.2 Control room and shift staffing

Licensee personnel who operate the plant are typically divided into crews who work and train together. The organization and minimum staffing requirements for the crews will be stated in the plant's operating license and administrative procedures. If the plant uses a rotating shift schedule, the crew will usually rotate as a unit. In addition to the number of supervisors and operators authorized and responsible to control the reactor, the key positions beyond the MCR staffing are identified. Some typical examples include a manager who is in charge of all site operations, operators, engineers (such as the shift technical advisor), health physics technicians, chemists, maintenance personnel, security staff, and firefighting personnel.

On a periodic basis the inspectors need to consider asking some of the following questions during a MCR visit:

- Does the shift meet the minimum staffing requirements?
    - If not, what action has the licensee taken?
    - Are these actions in accordance with regulatory requirements and the licensee's procedures?
    - How long is the licensee allowed to operate below the minimum staffing requirements?
    - Are their qualifications current?
- Is anyone in the MCR working overtime?
    - If yes, how long can they remain on shift?
    - Is overtime being routinely used to ensure the minimum staffing requirements are met?
    - Are there any restrictions on how long an operator can remain on shift?
- Do any operators have medical or other types of restrictions?
    - What compensatory actions does the licensee take when that person is on shift?
    - How often is the condition evaluated to determine it has changed?
- Are supervisors and operators allowed to have short term, temporary relief from their position?
    - If yes, what are the requirements and restrictions for this type of relief and are they being met?
- Are MCR operations being conducted in a calm, professional and competent manner?
- Are communications being conducted in accordance with licensee procedures and expectations?
- Are there additional personnel in the MCR beyond the normal shift staff?
    - What activity or test are they performing?
    - Are the operators aware of the scope of the activity?
    - How do the additional personnel communicate with the control room staff?
    - Is it clear to you that the operators have control over the activity?
- Is the MCR operating personal using self-checking? (Self-checking is a technique in which a person consciously and deliberately reviews the intended action and expected response before performing the action in question. A common method for self-checking is STAR: Stop, Think, Act, Review).

4.4.3 Control panel walkdown

The control panels are a large, complex set of displays, instruments, alarms, and controls the operators use to safety operate the plant and, if required, mitigate a transient condition. The control panel indications may be analogue, digital or a combination of the two technologies. The control panels are designed in such a manner that a trained, knowledgeable operator can briefly scan them to determine if conditions are stable and the NPP is within normal operational limits. The control panels may contain simplified system figures or diagrams to help reduce operator errors.

The licensee will have procedures which identify personnel who can operate plant equipment, and who is allowed to approach the control panels. The areas near the control panels have restricted access and are sometimes identified as At the Controls Area. This area may be marked by different coloured tile or carpet, lines on the floor, or rope barriers. Inspectors normally do not enter the At the Controls Area without explicit approval, in accordance with plant procedures.

When you walk down the control panels, determine if the values of parameters being displayed and the equipment in service are consistent with the power level and operational condition. Ask the operators to explain anything that is unusual or that you don't understand. Be sensitive to the on-going activities in the MCR and only ask when the level of activity permits.

Inspectors may consider some of the following questions during a MCR panel walkdown:

- Are the operating parameters and the equipment in service consistent with the plant's power level, operational condition, and regulatory requirements?
- Are there any alarm/warning annunciator lights illuminated on the control panels?
    - Can the operator explain them?
    - How are the operators alerted if the alarm/warning annunciator light clears (resets)?
- Are any control panel alarm/warning annunciator lights OOS?
    - What compensatory actions has the licensee taken to alert the operators that a new degraded condition exists or that the degraded condition has cleared?
- Is any equipment OOS or in a degraded condition (as identified through Equipment OOS tags, or other Warning or Information tags)?
    - When is the equipment expected to be returned to service?
    - What compensatory actions has the licensee taken?
    - How is the licensee managing risk while this equipment is OOS or degraded?
    - What are the licensee's contingency plans if the redundant equipment fails?
    - Are there any new operator actions associated with the compensatory actions?
        - Have operators been trained on the new actions?
        - Are new procedures needed to perform the actions?
        - Is any equipment needed to perform the additional actions and is it available?
    - How much has the risk of an accident increased or the ability to mitigate an accident decreased?
    - How long can the equipment remain OOS before the plant must be shut down?
    - Are the operational limits and conditions and the regulatory requirements (e.g., Technical Specifications) being met?
    - When did the equipment become degraded or OOS?
    - Are control panel indications such as temperatures, pressures, flow, and alarm/warning annunciator lights consistent with the abnormal equipment configuration?
- Is there any temporary monitoring, recording, or test equipment installed on the control panels?
    - Does the equipment produce an alarm, warning signal, or protective function?
    - What actions should the operators take if an alarm occurs?
    - How will that equipment affect the operation of other alarms, displays, or indications?
    - Was there a safety evaluation to determine if the installed equipment would create a situation not previously analyzed?
    - When will the equipment be removed?
    - Who is responsible for installing, maintaining, and removing the equipment?

4.4.4 MCR administrative controls and documents

The safe operation of a nuclear power plant also requires useful procedures and administrative controls. The onsite inspector needs to be familiar with these administrative controls and the other documents used by the MCR staff. Evaluating these documents can provide additional information related to the status of the plant and its recent operational performance. If possible, review the Shift Supervisor and Control Room Operators' logs prior to the MCR tour.

Some examples of the documents that inspectors normally evaluate are:

- Standing orders and Night orders;
- Shift Supervisor and Control Room Operators' logs;
- Equipment OOS log;
- Chemistry logs;

- Technical specification logs;
- Plant risk evaluations;
- Control panel alarm logs;
- Temporary operating procedures;
- Logs that list degraded equipment;
- Logs that list temporary modifications;
- Logs that control keys required for entry into sensitive rooms (e.g. high radiation areas, remote shutdown panels, security doors).

In addition, on a periodic basis, the inspector verifies the presence of the most recent versions of the following:
- Alarm response procedures;
- Operating procedures;
- Abnormal operating procedures;
- Emergency operating procedures;
- Severe Accident Management Guidelines;
- Work authorization procedures.

The MCR logs are evaluated as part of the regulatory body's overall assessment that the licensee's activities are being safely performed in compliance with regulatory requirements. If the inspector has not been on site for some time, reading the logs since their last tour will be beneficial to the inspector to understand the recent operational performance of the plant and its current status.

Use the information in the logs to identify activities which may have reduced the ability of the plant to mitigate an accident or that may have increased the risk of an event occurring. Identify areas which require clarification or additional follow up.

Below is a list of items which may appear in the logs and require additional follow up. This list in not intended to be a comprehensive list nor is it intended to replace an inspection procedure or checklist.

- Major Equipment Status Change;
- Major System and Equipment Testing;
- Mode changes;
- Load changes;
- Any LCOs entered or exited during the shift;
- Reactivity changes;
- Time of criticality and associated critical parameters at the time of criticality;
- Performance of surveillance testing and all important parameters recorded during surveillance tests;
- Reportable occurrences;
- Safety related equipment maintenance in progress;
- Entering or terminating (leaving) a Technical Specification Action statement;
- Isolation/taking into service of system/equipment;
- Implementation of Emergency Plan;
- Significant changes in radiological conditions;
- Planned or unexpected discharge of radioactive effluents including start and stop times;
- Significant communication with the plant operator or senior management or load dispatcher;
- Electrical switching activities that could affect the stability of plant;
- Public telephone calls involving security threats, pranks or complaints against the utility or plant;
- Official weather warnings or alerts;

- Occurrence of significant events, such as reactor scram, unexpected power changes, radiation exposures, personnel accidents or injuries and security incidents;
- Entries considered important by the MCR personnel;
- Any advice or instruction to the coming shift;
- Any special instruction or work plan received from the senior management;
- Any system or equipment, which is not operable as per Technical Specification;
- Administrative lockout;
- Work Authorization issued and work request raised in the shift.

If a plant transient or emergent equipment issued occurred since the inspector's last MCR tour, the inspector needs to consider asking some additional following questions regarding plant status:

- For plant transients or emergent equipment issues:
    - Is the plant currently stable and operating in accordance with regulatory requirements, license conditions, and operating procedures?
    - Has the licensee initiated some form of root cause evaluation?
    - Have the causes of the transient been identified, evaluated, and corrected?
    - Were there any unexpected plant or component responses?
    - Did the equipment and operators respond as expected?
    - Has the licensee gathered and protected the data and records from the event?
- For any equipment which is OOS:
    - Why was the equipment taken OOS? (e.g., maintenance, testing, damage)
    - What compensatory actions have been taken?
- Is this information consistent with the current plant status?

4.4.5 Shift turnover

Before you attend a shift turnover, know when the shift turnover starts and be there prior to that time. Take notes and only ask questions when the turnover is complete. If you are new or you haven't seen this shift crew before, introduce yourself. Be sure you do not appear to approve or endorse any activity.

Inspectors may use the turnover to evaluate whether the staff:

- Follows turnover procedures, such as:
    - Did the outgoing person complete the necessary log entries?
    - Did incoming and outgoing person discuss the important issues?
- Is focused on minimizing risk?
- Is aware of the overall status of the plant?
- Has determined that shift staffing satisfies minimum shift complement requirements?
- Understands, at all times during the shift turnover, who is responsible for the safety of the NPP.

4.4.6 Main control room habitable environment

The MCR is typically designed to provide a safe environment to control the plant during normal and abnormal situations. Additionally, in the event of an emergency, the MCR can (usually) be isolated from the plant and the external environment in order to maintain the area habitable. To do so, the control room has independent systems to provide radiation shielding, emergency ventilation, heating and cooling, sanitation, and monitoring in order to provide safe, continuous occupancy during accident conditions.

One component that is shared by many of these systems is the MCR access door. It acts as a security barricade, a fire barrier, and a pressure boundary. It offers radiation protection and is a missile shield in the event of a HELB. The door must be able to demonstrate all these functions while still offering easy access and egress to the MCR. As you enter the MCR, make an informed assessment to determine if the door is capable of performing all if its safety related functions. Also, be aware that there may be more than one access point for the MCR.

The MCR ventilation system will have different modes of operation based on plant conditions. In addition to the everyday, normal mode, the ventilation system can be placed in other configurations to maintain the area habitable. If an abnormal situation or an emergency event such as high radiation, toxic gas, or a HELB occurs, the system will automatically be reconfigured to protect the staff. If you are the onsite or resident inspector, you need to understand the different operating modes of the ventilation system and be aware of its current status when you enter the MCR.

If the MCR becomes uninhabitable, the inspector needs to know the locations of alternate control panels (secondary, remote), the route to each panel under emergency conditions (fire, flood, security, seismic, etc.) and periodically confirm the access pathways to the alternate/secondary/remote control panels are open/not obstructed.

4.5. CONTAINMENT

During plant outages, inspectors have an opportunity to inspect areas not normally accessible. There are benefits to performing initial entry and close out inspections when containment is accessible. In addition, outages provide inspectors the opportunity to perform walkdowns of SSCs in containment.

When entering the containment, the inspector must understand the licensee's containment entry programme and its provisions for ensuring the safety of personnel (including fall protection, heat stress and confined spaces). The requirements may include pre-job briefings, access and egress controls, stay time monitoring (ALARA and heat stress), FME controls, contingency planning, personnel accountability, in containment telecommunications features, and operation and controls for the containment airlocks (normal and emergency). The information in this paragraph is closely aligned with the Nuclear Regulatory Commission (NRC) Inspector Field Observation Best Practices, NUREG/BR-0363, Rev.1 [7].

4.5.1 Inspection inside the containment

When inside containment, inspectors need to consider:

- Inspecting licensee tests of containment integrity (leak tests). (This may be performed by a specialist.)
- Questioning the presence of permanent structures in close proximity to the containment walls (e.g. impact in case of seismic event)
- Inspecting for indications of leakage:
  - Stains;
  - Water or oil;
  - Boric acid;
  - Rust/corrosion;
  - Coating delamination, peeling, flaking, etc.
- Inspecting the containment emergency core cooling suction sump
  - Confirm the integrity of suction strainer;
  - "Look for oil in containment sumps. This may be a symptom of leakage problems with equipment requiring lubricants for operation" [7].
  - Verify that there is no strainer blockage or loose material to block the strainer.
- Inspecting piping and equipment supports, including bracing, hydraulic and mechanical snubbers, etc.;
  - Look for damage or deformation;

  - Look for hydraulic oil leaks;
  - Look for loose fasteners.
- Inspecting for loose paint or damaged insulation on piping and equipment;
- Inspecting piping and equipment for damage;
- Inspecting for cracks in concrete;
- Inspecting for damaged cable insulation;
- Inspecting containment liner for corrosion and loose paint;
- Inspecting moisture barrier between containment liner and containment slab for degradation;
- Inspecting the ability to reinstate containment integrity. "Most plants are required to be able to expeditiously isolate containment under certain conditions during outage activities. If this capability is required, verify that the plant maintains capability to quickly restore containment integrity" [7].

4.5.2 Containment closeout

Prior to the licensee closing containment, the inspector may consider performing an independent close out inspection. If possible, the inspection is scheduled so that the licensee has performed the necessary tests/actions and their close out inspections. The inspection would normally cover the following:

- Temporary plant equipment - During the course of an outage, the licensee may install temporary equipment in containment such as fans, water hoses, electrical extension cords, scaffolding, lighting, pumps, etc. When the licensee has completed their outage, verify that the temporary equipment has been removed. The removal of this equipment will help reduce the threat to the operability of the containment sump and other mitigating systems;
- Fibrous Material - When the containment is closed after outage activities, verify that plant personnel have removed fibrous materials and other materials that could threaten the operability of the containment sump or other mitigating systems;
- Coatings - Like fibrous material, containment coatings such as paint can peel or chip and threaten the operability of the containment sump or other mitigating systems. During a containment tour, look for this condition. Prior to containment closeout, verify that plant personnel have identified and resolved containment coating issues;
- Other Foreign Material - Prior to final containment closeout, verify that plant personnel have removed foreign materials that could migrate to the sump during design basis accident conditions. Such foreign materials include plastic tie wraps, duct tape, rope, flashlights, paper, loose insulation, loose insulation covering, plastic sheeting, loose bolts, fasteners and tools;
- Structures Near the Containment Wall – If structures have been added or modified, verify that the licensee has evaluated the distance between the structure and the containment wall to ensure that containment integrity is maintained during a design basis or seismic event.

The information presented in section 4.5.2 is closely aligned with the NRC Inspector Field Observation Best Practices [7].

4.6. INSPECTIONS DURING OUTAGES

Due to the increase in the number of activities and personnel in the facility during outages, it is important that inspectors thoroughly plan inspection activities and remain focused on safety relevant issues and, in particular:

- Determine how the licensee controls contractors;
- Perform unannounced inspections (including during nightshifts, weekends and holidays);
- Verify required safety equipment has been appropriately protected;
- Monitor outage performance (reportable events, doses, personal contamination events, etc.);

- Verify that outage heat sinks remain available;
- Monitor risk configuration and management, such as electrical power, decay heat removal and reactor coolant inventory and reactivity control (including shutdown margin);
- Verify radiation protection and contamination controls;
- Monitor licensee contingency plans for key safety functions and equipment;
- Verify all equipment used for fuel manipulation have been tested prior to start of fuel manipulation;
- Verify reactor coolant inventory control, including make up sources and operations with potential to drain the reactor vessel;
- Inspect refueling floor and spent fuel pool activities:
  - Criticality control;
  - Fuel movement including verification of fuel integrity;
  - Neutron absorber degradation;
  - Time to boil;
  - FME control;
  - Nuclear material accounting.

5. SPECIFIC INSPECTION CONSIDERATIONS

The material presented in the following sections is intended to be additional information the inspector may find useful when preparing for and when performing walkdowns and inspections. This information is not intended to replace the regulatory body's inspector training programme or inspection procedures and checklists, nor is it intended to be all inclusive. This information is intended to be an additional tool to use during the inspectors' assessment of the licensee's activities.

5.1. RADIATION PROTECTION, EFFLUENTS, WASTE MANAGEMENT

Radiation protection and effluent and waste management are specialized areas for which the regulatory body will have detailed inspection procedures. Specific inspections are normally performed by specialists in those fields. However, resident inspectors and other regulatory inspectors need to maintain an awareness of whether the licensee is following its radiation control and waste management procedures.

5.1.1 Radiation protection

During inspection of the NPP operations, maintenance, and other activities inspectors routinely evaluate whether the activities are being performed in accordance with radiation safety standards and requirements. In particular, the inspector may want to assess whether:

- Radiation dose rates are appropriately posted and independently verify the dose rates;
- Access to high and very high radiation areas appropriately controlled with proper boundaries;
- Check whether workers are using appropriate dosimetry or other required RP equipment. Ensure that these instruments and equipment are operable, calibrated and used in accordance with the instructions given;
- Check whether the licensee is maintaining worker dose as low as reasonably achievable (ALARA) using radiological controls such as time, distance and shielding;
- Radiation Work Permits, display of warning signs, postings, barricades and maintaining of locks, portable dosimeters are in place and being used;
- Plant workers are properly donning protective clothing before entering the area and properly removing their protective clothing upon exiting the area;

- Workers passing tools and other equipment across contaminated area boundaries are following good radiation protection practices and do not violate or compromise radiation boundaries.

In general, areas with radiation levels of greater than 10 mSv/hr must be controlled by a locked door; areas greater than 1 mSv/hr and less than 10 mSv/hr must be controlled through some type of barricading device, such as a door or swing gate. While in the plant the inspector may consider verifying:

- doors or other barriers to these areas are properly controlled;
- that walls or other barriers, such as fences, do not have openings and are of sufficient height so that an individual cannot easily enter the area;
- that an unauthorized individual cannot gain access to a very high radiation area.

The information presented in section 5.1.1 and its subsections is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.1.1.1 Refueling outages

During refueling outages, the inspection normally verifies that:

- Refueling activities are carefully controlled to prevent overexposures;
- The operators are maintaining calculations on time to boil the water in the spent fuel pool;
- Access is properly controlled to radiation areas;
- Check contract workers are trained in radiation protection & industrial safety area;
- Check radiation incidents are being reported?
- Check the highest individual doses and task specific doses and collective doses are as per estimation.

5.1.1.2 Temporary radiation shielding

"Lead blankets, sheets, and blocks are sometimes used to shield personnel from radiation sources such as piping systems, components, etc. If licensee staff has attached blankets, sheets, and blocks directly to piping and supports, the weight can stress the components. Temporary shielding normally has its own structural support. Temporary shielding should not be supported by the system components unless analysis has verified that the additional weight is acceptable" [7].

- Is it adequate to reduce the radiation field?
- Is it removed when no longer necessary (has it become permanent or should permanent shielding be installed)?
- Ask if there is any radiation streaming and is access controlled.

5.1.1.3 Contamination control

The inspector may want to verify that contamination is being properly controlled through:
- Cleaning and decontamination;
- Establishment of rubber area at hot job areas;
- Strict control on movement of tolls / equipment;
- Establishment of RP post;
- Ventilation from low to high contaminated areas;
- Designated contaminated areas with protective clothing requirements;
- Routine Surveys for contamination monitoring and results are being displayed at appropriate location;
- Warning signs are posted in all areas, rooms and on containers with significant amount of radiation or radioactive material in accordance with plant procedures.

5.1.2 Release of effluents

The main objective of the regulatory inspections in connection with the release of airborne and liquid effluents to the environment is to assess whether the regulatory dose limits for members of the public established are being met by the licensee. To accomplish this, the inspector must know the discharge limits authorized by the regulatory body for the installation being inspected.

5.1.2.1 On Site monitoring

- The licensee's programme for on-site effluents monitoring is normally the basis for the inspections;
- All the radioactive measurement devices used for the systems of effluent management and radioactive releases (such as in tanks, pipelines, end of pipeline and stacks) are identified, inspected and verified in accordance with plant procedures;
- The inspector may consider checking that all the records for radioactive measurements and performance indicators (such as efficiencies, flux and volume controls, etc.) for these systems are created and maintained under a quality management system by the operator.

5.1.2.2 Off Site monitoring

- The licensee's programme for environmental monitoring approved by the regulatory body is normally the basis for the inspections;
- The inspector may want to verify the off-site sample locations for airborne, sediments in soil and river/lakes/sea, underground water, food and that they are sampled periodically with methods and threshold reporting criteria established in the monitoring programme approved by the regulatory body;
- Discharge points such as end of pipelines (or the related storage tanks) stacks and vents are identified and monitored in accordance with plant procedures. The inspector may consider verifying the measurements taken by the operator by audit of the quality management programme (including records and calibrations) and establish a programme of independent measurements.

5.1.3 Waste management

The main objective of the regulatory inspections in connection with the waste management is to assess whether the licensee is managing its waste in accordance with license and regulatory requirements and maintaining dose the regulatory dose limits for members of the public established are being met by the licensee. To accomplish this, the inspector needs to evaluate the following:

- The waste management programme for the facility;
- The training and qualifications required by the workers;
- A basic knowledge of the regulatory requirements for transportation of radioactive waste (including pre-transportation and arrival surveys);
- The Waste Acceptance Criteria for processing, storage and/or disposal of radioactive waste for the facility including records and reporting as required by the regulatory body, for accountability and traceability of radioactive waste throughout the different processes of radioactive waste management;
- The waste minimization and segregation programme and observe how it is implemented through the station;
- The transport package requirements for material transported on and off site.

5.2. OCCUPTIONAL AND INDUSTRIAL SAFETY

An NPP is a complex industrial environment which contains many industrial and occupational hazards such as high temperature and pressure fluid systems, high voltage electrical devices, ionizing radiation, trip and fall hazards. As an inspector, you need to be aware of the occupational and industrial safety hazards in the plant.

In some Member States, the regulatory body has the regulatory oversight responsibility for occupational and industrial safety at the NPP. If that is the case, then the inspector will have defined responsibilities for evaluating how well the licensee's complies with industrial safety standards. Those responsibilities may include items such as verifying that personnel safety devices installed in the plant are in good material condition and that workers are not engaging in unsafe work practices. In every case, if the inspector identifies potential hazards, the concerns are normally reported to the licensee (and regulatory body as necessary) to ensure they are evaluated and resolved. This paragraph is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.2.1 Occupational safety

The inspector needs to understand and follow the licensee's occupational safety requirements. If the licensee requires safety training before staff and contractors are allowed on site, then the inspector would normally complete the training before entering the plant and performing inspections. In some cases, the regulatory body will have an equivalent training programme which may be completed instead of the licensee's program. Regardless of which organization provides the training, when the inspector enters the facility, the inspector must follow with the license's requirements.

5.2.2 Personal protective equipment

All inspectors and facility personnel must follow the licensee's requirements for using personal protective equipment (PPE). If the inspector identifies that licensee and/or contractor personnel are not following the requirements, then the inspector may inform licensee management of the concerns. As stated above, the licensee is expected to evaluate and address the issue. The following are some typical examples of personnel **not** following PPE requirements:

- Not wearing all required hearing protection, eye protection, or head protection (e.g., a hard hat);
- Not using additional protection based on local conditions. For example, not using double hearing protection during emergency diesel generator testing;
- Not using a lanyard with a break away feature for the display of identification badges and dosimetry;
- Not tucking in neckties or any other loose clothing in the vicinity of rotating equipment;
- Not wearing footwear that is in good condition and that provides protection against injury due to falling objects.

The information presented in section 5.2.2 is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.2.3 Other industrial safety considerations

The examples provided below identify some of the various types of hazards and safety concerns the inspector may encounter at an NPP. The lists are for information only and are not intended to be exhaustive or to replace the regulatory body's inspection procedures and checklists. The information presented in section 5.2.3 and its subsections is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.2.3.1 Fall related hazards

The most frequently treated injuries at a NPP often result from a fall or a trip. The following are some accepted good practices to determine if trip and fall hazards are being minimized.

- Stairway and platform hand rails are attached securely;
- Permanent ladders are firmly attached to anchor points and do not wobble;
- Licensee personnel are using moveable ladders in a safe manner:
  - Additional personnel are acting as a ladder tender to help avoid a fall;
  - Not standing on the top step of a ladder;
  - Being extra cautious when carrying items while climbing up or down a ladder.
- Workers use safety harnesses when required;
- Trip and Fall hazards are clearly marked;
- Bump hazards such as low hanging pipes are clearly marked;
- Floor grates, drains, and drain covers are secure in place or are barricaded clearly;
- Wet floors or standing water puddles are clearly identified. This could be a radiological hazard, especially in a boiling water reactor.

5.2.3.2 Electric shock

Electrical shock most commonly occurs from working on open wires while components are energized and from the use of unsafe extension cords and temporary service leads. Electric shock has resulted in fatalities at NPPs. Verify that this work is done in a safe manner (e.g., equipment is tagged out and deenergized) and workers are using appropriate safety equipment.

5.2.3.3 Heat stress

Some areas of nuclear power plants may have high heat and humidity levels due to operating equipment, steam lines, and limited ventilation. Verify that licensee personnel are following the precautions and requirements to protect workers from heat related stress.

5.2.3.4 Confined space entry

Confined space accidents have resulted in fatalities at NPPs. Environments in which the oxygen levels are limited or unknown or where toxic gases are present are considered to be confined space areas. Entry into these areas is strictly controlled. Examples of areas which may not be immediately obvious as being a confined space hazard include: storage tanks, condensers, underground pipe tunnels or vaults, sewer lines, and ventilation ductwork. As an inspector, verify that personnel entering these areas are trained and qualified, that a confined space entry permit has been obtained and is posted, and that the plant is meeting all other confined space entry requirements.

5.2.3.5 Diving activities

In some instances, divers are required at NPPs to perform maintenance and surveillance activities. Diving accidents have resulted in fatalities at NPPs. Ensure the licensee is following the precautions and requirements needed to safely accomplish the diving activity. As an inspector, verify that control room personnel are aware that diving activities are occurring and that controls are in place to protect the divers and prevent operating equipment in the vicinity of the divers.

5.2.3.6 Smoking area locations

Verify that designated smoking areas are not near tanks which store potentially explosive gases (such as hydrogen) or other combustible materials.

5.2.3.7 Normal lighting and emergency lighting

- Verify that areas routinely entered by plant personnel are sufficiently illuminated to avoid a fall or other injury. For areas that are not routinely accessed, verify that personnel are using flashlights or that adequate temporary lighting is installed;
- Verify normal lighting is adequate to safely perform routine activities including ingress and egress;
- Verify emergency lighting is available where necessary to perform critical tasks;
- Verify the emergency lighting provides safe ingress and egress and that there is no apparent damage to the units, lights, or battery.

5.2.3.8 Scaffolding

Scaffolding is (usually) a temporary structure used to allow access hard to reach areas for activities including construction, operation, maintenance, repair, and testing. While scaffolding is not a component like the SSCs described earlier in this handbook, it is routinely used on or near safety related equipment. If not properly installed and maintained, it can prevent the SSCs equipment from performing their safety related functions. Scaffolding can also present many personnel safety issues.

The following are some accepted good practices to determine if scaffolding has been properly erected and hazards are being minimized.

- The scaffolding has toe boards to prevent tools and other heavy objects from accidently being kicked off the scaffolding onto someone below;
- The general condition of the scaffolding is good;
- A tag is in place indicating that the scaffolding has been inspected and approved.

There is an Inspection Guide in the Annex for scaffolding and ladders which contains questions the inspector may find useful during inspections. The Guide is not intended to replace the regulatory body's inspection procedures, nor should it be used as a comprehensive check list. The Guide is an additional tool for the inspector to use during assessment of the licensee's activities.

5.2.3.9 Compressed gas cylinder storage

Due to their relatively high centre of gravity when in the standing in an upright position, compressed gas cylinders can cause a worker injury if not properly stored. Verify that these cylinders are capped and controlled to prevent them from falling over. A punctured cylinder or broken valve can become a missile hazard when the compressed gas discharges.

5.2.3.10 Total flooding gaseous suppression areas

Total flooding gaseous suppression systems can create rooms or spaces with low oxygen or toxic gas environments. Areas such as an emergency diesel generator room or a motor control center may use a gas, such as carbon dioxide (CO_2), instead of water to extinguish a fire. For these enclosed spaces or rooms, verify that all egress doors are properly labeled to warn occupants of a possible system discharge which could create a hazardous environment.

5.3 WEATHER RELATED HAZARDS

The inspector needs to be become familiar with the licensee's operating experience, corrective action program, Updated Final Safety Analysis Report (UFSAR), etc., to determine the types of seasonal and/or storm related adverse weather challenges to which the site is susceptible. This review shall be performed for the types of weather related risks identified for the site. The inspection for the adverse weather condition is normally performed prior to experiencing expected seasonal temperatures extremes and when expected adverse weather conditions are imminent at the site. When selecting a sample, it is recommended that the inspector consider multiple systems that are collectively risk significant.

5.3.1 Evaluate summer readiness of offsite and alternate AC power systems.

The summer can bring extreme heat conditions to a geographical area resulting in a high demand for power due to the increased use of building cooling systems (i.e., air conditioning, etc.). This may result in additional demand on the electrical grid. The inspector may verify that plant features, and procedures for operation and continued availability of offsite and alternate AC power systems are in place in the event of grid instability. Inspect the licensee's procedures affecting these areas and the communications protocols between the transmission system operator and the NPP to verify that the appropriate information is exchanged when issues arise that could impact the offsite power system. Examples of appropriate information to be conveyed would include:

- Coordination between the transmission systems officer and the NPP during an off normal or emergency event resulting in grid instability that may affect the NPP;
- An estimate of how long the condition is expected and when the offsite power system will be returned to a normal state;
- Notification to the NPP when the offsite power system is returned to normal.

Verify these NPP procedures address measures to monitor and maintain availability and reliability of both the offsite AC power system and the onsite alternate AC power system. Specifically, ensure they address:

- The compensatory actions identified to be performed if it is not possible to predict the post trip voltage at the NPP for the current grid conditions;
- Required reassessment of plant risk based on maintenance activities which could affect grid reliability, or the ability of the transmission system to provide offsite power;
- Required communications between the NPP and the transmission system operator when changes at the NPP could impact the transmission system, or when the capability of the transmission system to provided adequate offsite power is challenged. It is important to remember that the transmission system operator completely independent of the licensee.

5.3.2 Evaluate readiness for seasonal extreme weather conditions.

Most NPP sites experience seasonal weather changes that result in large temperature swings and other seasonal weather events such as hurricanes, monsoons, and high winds. Prior to the seasonal changes inspectors may want to consider:

- Reviewing of UFSAR, Technical Specifications, and plant documents, that the selected systems or components will remain functional when challenged by adverse weather. Verify that plant features and procedures for operation and continued availability of the ultimate heat sink (i.e., river, lake, and ocean) during adverse weather are appropriate. Additionally, evaluate the licensee's plans to address the ramifications of potentially lasting effects of adverse weather conditions (e.g., drought, flood);
- Performing a detailed inspection of the station's adverse weather procedures written for seasonal extremes (e.g., extreme high temperatures, extreme low temperatures, or hurricane season preparations);
- Verifying that weather-related equipment deficiencies identified during the previous year have been corrected prior to the onset of seasonal extremes;
- Evaluating implementation of the adverse weather preparation procedures and compensatory measures for the affected conditions before the onset of and during adverse weather conditions;
- Selecting for inspection 2 to 4 risk significant systems that are required to be protected from the adverse weather condition;

- Verifying cold weather protection features, such as heat tracing, space heaters, wet pipe sprinklers, standpipes, and weatherized enclosures are monitored sufficiently to ensure they support operability of the system, structure, or component (SSC) they protect. This includes instrument controller and alarm calibration programs as necessary to support the cold weather protection function. Perform necessary walkdowns to verify the physical condition of weather protection features;
- Verifying that operator actions defined in the licensee's adverse weather procedure maintain readiness of essential systems. Verify that minimum/adequate operator staffing is specified. (Note: Consider accessibility of controls, indications, and equipment);
- Assessing whether a system/component affected by the adverse weather condition is required for a reactor shutdown, verify that it would be available for performance of the reactor shutdown function under the weather conditions assumed prior to the shutdown.

5.3.3 Evaluate readiness for impending adverse weather conditions.

- Evaluate the overall preparations/protection of the risk significant systems for the weather conditions expected;
- Evaluate implementation of the adverse weather preparation procedures and compensatory measures for the affected conditions before the onset of and during adverse weather conditions. Inspect the licensee's plans to address the ramifications of potentially lasting effects that may result from the adverse weather conditions (e.g., drought, flood);
- Verify that operator actions defined in the licensee's adverse weather procedure maintain readiness of essential systems. Verify that minimum/adequate operator staffing is specified. (Note: Consider accessibility of controls, indications, and equipment.);
- Plant modifications, maintenance activities (i.e., temporary hazard barrier removal), new evolutions, procedure revisions, or operator workarounds implemented to address periods of adverse weather can inadvertently affect the risk profile for SSCs and need to be inspected. Determine that the licensee has assessed and managed these challenges to safe plant operation.
- "Verify that all loose metal objects (e.g., sheet metal or other metallic material that could present a shorting hazard to breakers, transformers, and other electrical equipment) have been properly controlled in the event of a tornado or other high wind condition" [7].

5.3.4 Evaluate readiness to cope with external flooding

External flooding can occur as a result of adverse weather conditions, earthquakes, failed dams, and other causes. As was demonstrated during the Fukushima Daiichi accident, external flooding can result in a significant effect on the NPP and ultimately the public health and safety [8]. This section is focused on external flooding and is not intended to address the much larger topic of external hazards. This information is intended to be an additional tool to use during the inspectors' assessment of the licensee's activities.

As related to external flooding, the inspectors may want to:

- Inspect flood protection barriers and evaluate procedures for coping with external flooding;
- Review the FSAR, PSAR, and other flood analysis documents to identify those areas that can be affected by external flooding, including water intake facilities. Evaluate seasonal susceptibilities such as floods caused by hurricanes, heavy rains and flash flood. Inspect licensee documentation that shows the design flood levels for areas containing safety related equipment. Assess problem reports and corrective actions for past flooding events;
- Based on licensee's flooding risk studies, select plant areas containing risk significant SSCs which are below flood levels or otherwise susceptible to flooding. Use weather related information gathered during plant status reviews or from external news sources to assist in scheduling this inspection prior to the season of highest risk;

- Perform a walkdown of the selected areas or rooms. By direct observation and/or design evaluation (including preventive maintenance activities), consider the following, giving priority to those attributes which are risk significant for the site-specific installation:
  - “Sealing of equipment below the flood line, such as electrical conduits” [7];
  - “Sealing of equipment floor plugs, holes or penetrations in floors and walls between flood areas” [7];
  - “Adequacy of watertight doors between flood areas” [7];
  - Common drain system and sumps, including floor drain piping and check valves, were credited for isolation of flood areas within plant buildings;
  - Verify that the drain system has adequate protection (screens/covers) to prevent debris from disabling the drain system or components in the drain system;
  - Operable sump pumps, level alarm and control circuits including maintenance and calibrations of flood protection equipment;
  - Sources of potential internal flooding that are not analyzed or not adequately maintained, for example failure of flexible piping expansion joints, failure of fire protection system sprinklers, roof leaks, rest room backups, and failure of service water lines;
  - Condition and availability of temporary or removable flood barriers (i.e., gaskets).

- Inspect underground bunkers/manholes subject to flooding that contain multiple train or multiple function risk significant cables. Consider the following attributes which are risk significant for the site-specific installation:

  - Verify by records inspection that operable sump pumps will deliver at the expected flow rate established by the licensee’s design basis documentation or FSAR;
  - Verify level alarm circuits are set appropriately;
  - Cables/splices subject to submergence appear intact;
  - Determine whether drainage is provided for the bunkers/manholes selected

  NOTE: The intent is not to inspect bunkers/manholes that are welded shut, or to request extraordinary effort by the licensee to open bunkers/manholes for inspection unless a problem has been identified, or is suspected, that could adversely affect risk significant component(s). Inspectors need to be aware of when bunkers/manholes are being opened by the licensee and take advantage to inspect. If such opportunity is identified, the inspector normally selects the bunkers/manholes to be inspected based on the licensee’s inspection activities as much as possible.

- For those areas where operator actions are credited, verify that the procedures such as abnormal or emergency procedures for coping with flooding can reasonably be used to achieve the desired actions, including whether the flooding event could limit or preclude the required operator actions;
- Evaluate implementation of flood protection preparation procedures and compensatory measures during impending conditions of flooding or heavy rains;
- If flood barriers have been removed for maintenance (or other activities), verify the adequacy of the compensatory measures established;
- Verify the licensee has evaluated any unsealed concrete floor cracks.

5.4 FIRE PROTECTION

Fire can be a significant contributor to risk at an NPP. To help reduce the risk, the concept of defence in depth is applied to the fire protection program. Fire protection includes preventing fires from starting; rapidly detecting, controlling, and extinguishing those fires that do occur; and providing protection for SSCs important to safety so that a fire that is not promptly extinguished will not prevent the safe shutdown of the reactor.

Fire protection is a specialized area which has detailed inspection procedures. Inspections are usually assigned to specialists. This section is included to provide the on-site inspector with a general understanding of what they may want to look for during routine plant walkthroughs.

The following are some examples of what inspectors need to look for in the plant:

- Access to manual fire protection equipment (such as hose reels and extinguishers) is not obstructed. Fire extinguishers are in good condition and charged;
- Fire protection sprinkler heads are not obstructed by equipment or maintenance activities;
- Verify hot work is being performed in accordance with fire protection procedures (e.g. hot work permits issued, fire watch station, etc.);
- As part of the systematic inspection of the fire protection program, the regulatory body may consider taking advantage of the opportunity, during the outage, to inspect areas that are inaccessible during normal operation;
- The inspector needs to be aware of the premature introduction of combustible materials (often by workers eager to start work). Also, to inspect for the extent of flammable fluid leaks present at the beginning of the outage. This includes the evaluation of the licensee's efforts to reduce the extent of the flammable fluid leaks throughout the remainder of the outage.

The information presented in section 5.4 and its subsections is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.4.1 Transient combustibles, materials, and equipment

The following are some examples of what inspectors need to be aware of regarding combustibles in the plant:

- Any combustible materials in the area meet the requirements specified by the licensee's Control of Transient Combustibles procedure. Note that the licensee may have a different title for the procedure;
- Transient load restrictions are satisfied as specified by the licensee's housekeeping procedures;
- All temporary equipment in the area (such as hoses, sump pumps, cables, barriers, or shielding) is controlled by procedure or by approved temporary modification;
- Epoxy floor coatings can, under certain circumstances, represent a signification and unanticipated fire load if not property procured and applied. Verify that these coatings do not exceed the vendor's recommendation in thickness (typically no more than about 1/8 inch [~ 3 mm]) and bring any discrepancies to the attention of licensee personnel;
- Confirm that if combustible materials (e.g., wood, cardboard, etc..) are used in a radiologically controlled area, it is coated with an approved fire-retardant material;
- Any materials for temporary use during outage period are fire resistant, as practical as possible;
- The temporary bulk storage of flammable or combustible liquid (e.g. lube oil, diesel drum) has appropriate fire protection controls.

5.4.2 Fire suppression systems

The following are some examples of what inspectors normally look for regarding fire suppression systems in the plant:

- Verify by visual observation that sprinkler heads are not obstructed by overhead equipment, that water supply valves are open, and that the fire water supply and pumping capability is available;

- Where a jockey pump maintains the fire protection water supply pressure, note if system maintains steady pressure or if the jockey pumps are required to cycle excessively;
- Observe any material condition that may affect the performance of the system, such as leakage, mechanical damage, corrosion, damage to doors or dampers, open penetrations (open floor drains may preclude proper gaseous concentration following actuation), or nozzles or sprinkler heads painted or blocked by plant equipment;
- For gaseous systems, compare bottles to verify that the vent piping off the bottles is piped correctly;
- Verify that the suppression agent charge pressure is within the normal operating band and that supply valves are open as required;
- In rooms protected by total flooding gaseous suppression agents such as CO_2, be especially sure that egress door latches can be fully engaged. These rooms will pressurize upon system discharge. If door latches fail and allow the door to open, the room will not maintain design concentrations. Verify that all egress doors are properly labelled to warn occupants of a possible system discharge;
- Verify by visual observation that suppression systems nozzles are properly directed to objects which are protected from fire and unobstructed by other equipment and structure;
- Verify that open floor drains are neither obstructed nor blocked for water-based suppression systems;
- Verify by visual observation that selective valves are properly positioned for gaseous suppression system and are not mechanically damaged which may affect open/close operation.

5.4.3 Fire hose stations and standpipes

Verify that the general condition of fire hose stations is satisfactory:

- Fire hose is in satisfactory material condition;
- Fire hose nozzle is not mechanically damaged and is correct for the application;
- Valve hand wheels are in place;
- Fire hose reel is correctly mounted to the fire hose standpipe, has free movement, and is not otherwise obstructed by plant equipment;
- A spanner wrench is in close proximity to the fire hose station to aid in the operation of the isolation valve;
- If there is a seal to prevent a hose reel from unwinding, is it properly wired in place when not in use?
- Check if flushing of yard piping through fire hoses is being performed to avoid corrosion and confirm operability of fire hose;
- Observe the connections between fire hose and standpipe valves are free of mechanical damage, leakage, and corrosion.

5.4.4 Fire doors

Observe the material condition of the fire doors.

- Verify that fire doors are not propped open or prevented from closing fully (such as with temporary electric cords running through a door opening) without the required impairment permits;
- Verify that the door latching hardware functions properly;
- Verify that the doors are properly closed when not in use. CAUTION: fire door impairment (and periodic fire watch compensatory measures) may not be sufficient for the multipurpose door (fire/HELB/flood protection watertight).

5.4.5 Electrical raceway fire barrier devices

- Observe the material condition of electrical raceway fire barriers such as cable tray fire wraps.;
- Verify that no cracks, gouges, holes, rips, or gaps exist that could compromise the ability of the material to function properly.

5.4.6 Ventilation system fire dampers

Observe verify that fusible links are in place and appear to be in good physical condition.

5.4.7 Fire proofing

Observe the material condition of fire proofing materials and verify that the material is installed with all areas uniformly covered with no bare areas.

5.4.8 Fire barrier and fire area/room/zone electrical penetration seals

- Observe accessible electrical and piping penetrations and verify that seals are properly installed and in good condition;
- Verify that core bores (holes) drilled through concrete for the passage of electrical cables between fire zones are properly sealed with fire retarding material.

5.4.9 Roll-up fire doors

Verify that no objects or debris are in the path that would prevent the door from closing freely when needed (actuated).

5.4.10 Space heaters

Verify that authorized bodies have considered the following items before placing space heaters in service:
- Fire hazards or combustibles near the space heater;
- Damage to or effect on the operability of equipment;
- The effect of accelerated aging on the environmental qualification of electrical equipment.

5.4.11 Manual firefighting equipment

- Verify that the access to portable fire extinguishers is not obstructed by plant equipment or work activities;
- Verify that the pressure gauge reads in the acceptable range, that nozzles are clear and unobstructed, and that charge test records indicate that testing has been accomplished within the required periodicity;
- Verify that the extinguishers are in good material condition and are not corroded by feeling all surfaces, including the underside, for evidence of rust;
- Verify that fire brigade equipment is properly stored and maintained, and that personal protective equipment is in good condition and free of rips or tears. Equipment such as flashlights, radios, self-contained breathing apparatus, etc. need to be maintained in sufficient quantities and stored in accessible locations for fire emergencies;
- Verify the attendance of fire fighter in firefighting drills;
- Verify that fire fighters are well trained (e.g. refresher firefighting training, familiarization with plant layout & radiation protection trainings etc.)

5.4.12 Fire drills

Inspectors normally witness the fire drills performed at plant to evaluate the effectiveness of firefighting system.

There is an Inspection Guide in the Annex for fire protection which contains questions the inspector may find useful during walkdowns/ inspections. The Guide is not intended to replace the regulatory body's inspection procedures, nor should it be used as a comprehensive check list. The Guide is an additional tool for the inspector to use during assessment of the licensee's activities.

5.5 PROBLEM IDENTIFICATION AND CORRECTIVE ACTION PROGRAMS

The licensee needs to have an effective, well defined problem identification and corrective action program. The objectives of the programme are to identify, document, evaluate, trend, and correct non-conformances. The programme normally applies a graded approach to ensure that the most intensive evaluation is used for the most safety and risk significant concerns.

When an inspector informs the licensee of an observation, the licensee is expected to evaluate the issue to determine if there is an immediate safety concern and if immediate action is required. Even if no immediate action is needed, the licensee is expected to enter the concern into the corrective action programme for further evaluation and, if necessary, take corrective action.

If there is a significant plant event, the licensee performs an evaluation to determine the cause(s) and the extent of the condition as well as to implement short term and long-term corrective actions to prevent recurrence.

Below is information inspectors may find useful when inspecting the licensee's root cause evaluations. This information is not intended to replace the regulatory body's inspection procedures, nor should it be used as a check list. These are supplementary tools for the inspector to use during assessment of the licensee's evaluations.

The inspector may consider performing an independent assessment of the licensee's evaluation to:

1) Determine whether the root and contributing causes of individual and collective risk significant performance issues are identified and understood. The answers to the following questions may be helpful in determining the effectiveness of the licensee's evaluations.

   - Who identified the issue (i.e., licensee, self-revealing, or Regulatory Body)?
   - Under what conditions was the issue identified?
   - How long had the issue existed?
   - Were there prior opportunities for identification of the issue?
   - Does the licensee's evaluation identify (1) the plant specific risk consequences and (2) any compliance concerns associated with the issue?

2) Independently assess and provide assurance that the extent of condition and the extent of cause of individual and collective risk significant performance issues are identified. The answers to the following questions may be helpful in determining the effectiveness of the licensee's evaluations.

   - Was the problem evaluated using a systematic methodology to identify the root and contributing causes?
   - Was the evaluation performed at a level of detail commensurate with the significance of the problem?
   - Did the evaluation include a consideration of prior occurrences of the problem and knowledge of prior operating experience?
   - Did the evaluation address the extent of condition and the extent of the cause of the problem?
   - Did the root cause, extent of condition, and extent of cause evaluations appropriately considered safety culture as a possible contributing component?

3) Independently determine if safety culture components caused or significantly contributed to the individual and collective risk significant performance issues.

4) Provide assurance that the licensee's corrective actions for risk significant performance issues are sufficient to address the root and contributing causes and prevent recurrence. The answers to the following questions may be helpful in determining the effectiveness of the licensee's evaluations.

   - Are appropriate corrective actions identified for each root and contributing cause?
   - (if appropriate) Has the licensee performed an adequate evaluation justifying why no corrective actions are necessary?
   - Were the corrective actions prioritized with consideration of risk significance and regulatory compliance?
   - Has a schedule been established for implementing and completing the corrective actions?
   - Have quantitative or qualitative measures of success been developed for determining the effectiveness of the corrective actions to prevent recurrence?
   - Are the corrective actions planned or taken adequate to address enforcement issues that are related to this inspection?

5.6. OTHER INSPECTION CONSIDERATIONS

Whether performing a periodic walkdown of the facility or a specific inspection, there are many other things that inspectors needs to be aware of when they are in the plant. These include but are not limited to:

- The preconditioning of safety related equipment before testing or use;
- General station condition (Housekeeping);
- Evidence of the effects of a previous water hammer on plant piping and equipment;
- Whether the licensee staff is fit for duty to perform their duties to maintain plant and public safety;
- Proper tagging of equipment out of service;
- Whether safety related equipment has been appropriately qualified for its operating environment;
- The appropriate installation and use of digital I&C, freeze seals, heavy lifting equipment;
- The proper application and maintenance of painting, coatings and the use of chemicals that could adversely affect plant equipment and operation;
- The control of special processes such as welding operations;
- The opportunity to inspect normally concealed spaces and underground piping.

The following provides some information to consider when performing plant walkdowns and specific inspections.

5.6.1 Equipment preconditioning

During the inspection and surveillance testing of SSCs, the inspector may consider looking for evidence of unacceptable preconditioning of equipment prior to the test. In some cases, preconditioning may be acceptable. For instance, preconditioning may be based on the vendor's recommendations or on industry wide operating experience to enhance equipment and personnel safety. This preconditioning needs to be evaluated and documented in advance of the surveillance. It is recognized that this inspection guidance does not supersede the testing requirements of codes and standards that the licensee has committed to (e.g., American Society of Mechanical Engineers (ASME) Section XI for relief valves and safety valves).

However, the alteration, variation, manipulation, or adjustment of the physical condition of an SSC before or during technical specification surveillance or ASME Code testing that will alter one or more of an SSC's operational parameters and affect test results is not acceptable. Such changes could mask the actual as found condition of the SSC and possibly result in an inability to verify the operability of the SSC. In addition, unacceptable preconditioning could make it difficult to determine whether the SSC would perform its intended function during an event in which the SSC might be needed. Influencing a test outcome by performing valve stroking, preventive maintenance, pump venting or draining, or manipulating SSCs does not meet the intent of the as found testing expectations and may be unacceptable.

Preconditioning may or may not be acceptable, depending on circumstances associated with the particular test condition. The inspector needs to be aware that maintenance activities may mask identification of SSC degradation. Specifically, an activity performed by a licensee to precondition an SSC which results in acceptable performance at that specific time may not be acceptable. Routine preventive maintenance, such as valve lubrication and pump venting, might coincide occasionally with the in-service test program. In those cases, the effect of such maintenance needs to be evaluated to ensure that the ability to assess the operational readiness of the SSC and to trend degradation in SSC performance is not adversely affected.

The inspector may consider asking the following questions when evaluating the acceptability of preconditioning:

- Does the practice performed ensure that the SSC will meet testing acceptance criteria?
- Would the SSC have failed the surveillance without the preconditioning?
- Does the practice bypass or mask the as found condition?
- Is preventive maintenance routinely performed just before the testing?
- Is the preventive maintenance performed only for scheduling convenience?

5.6.2 General station conditions (housekeeping)

Poor housekeeping and plant material condition may not be, in of itself, a nuclear safety problem. However, poor housekeeping and material condition may be an indicator for other safety issues within the plant. For example, poor housekeeping within a facility may provide insights into the attitudes and safety culture of licensee leadership and management and the example they are setting for the rest of the workforce. Even though safety related equipment may not be involved instances of poor housekeeping and material condition that may indicate a lack of safety culture on the part of the licensee include:

- Unsecured gas bottles;
- Poorly constructed scaffolding;
- Poorly installed and maintained temporary equipment such as water hoses throughout the plant and temporary test equipment left in place after the testing is complete;
- The temporary storage of materials and equipment in areas that are not designated storage areas;
- Unrepaired concrete structures, damaged piping and supports and damage to other civil structures even if they are not related to safety;
- Unpainted surfaces that are resulting in corrosion;
- Oil spills that have not been properly contained and cleaned up;
- Loose fasteners on equipment and piping supports.

There is an Inspection Guide in the Annex for housekeeping and general material condition which contains questions the inspector may find useful during walkdowns/ inspections. The Guide is not intended to replace the regulatory body's inspection procedures, nor should it be used as a comprehensive check list. The Guide is an additional tool for the inspector to use during assessment of the licensee's activities.

5.6.3 Water hammer

Water hammer is an impulse load created by the sudden stopping and/or starting of a liquid flow which may occur when a valve is opened or closed. The resulting pressure load can have a catastrophic impact on pumps, pressure transducers, turbines, valves, and pipe supports. Water hammer events typically occur in milliseconds but may last several seconds in large systems.

- Does the station monitor gas accumulations in piping systems?
- How does the station ensure adequate measuring of gas accumulations?
  - Refer to Nuclear Regulatory Commission Generic Letter 2008-01 and Nuclear Energy Institute (NEI) document NEI 09-10.
- If there is any mechanical equipment to mitigate water hammers, is it tested?
- If water hammer occurs, how does the station perform a rigorous evaluation (detailed inspection)?
- Possible indications of a water hammer are:
  - supports that are loose, missing, or pulled out of the wall;
  - additional supports beyond the drawings;
  - supports in a different location from the drawings;
  - distorted piping supports.
- Listening for a **pinging** noise and/or visible piping system deflection during system start up.

The information presented in section 5.6.3 is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.6.4 Fitness for duty

"Note whether plant workers are exhibiting indications of fatigue or have alcohol on the breath, appear disoriented, or appear unfocused on the tasks they are performing. Immediately report any observations to licensee management" [7].

5.6.5 Tagging and clearing tags for out of service equipment

When equipment is taken out of service (OOS) for modification, maintenance, or testing it needs to be properly tagged in accordance with licensee procedures. Likewise, when equipment is returned to service, the licensee follows its procedures to ensure that it is safe to return the equipment to service. Improper performance of clearance (tagging) activities can lead to personnel safety hazards such as electrical shock and can increase plant risk by compromising defence in depth. The inspector must understand the importance of tagging and locking out equipment and must be aware of the licensee requirements for tagging or locking out equipment and returning it to service. During routine plant walkdowns the inspector may want to verify the clearance tags have been properly hung by comparing the information on the tags with the configuration of the equipment. If the inspector cannot confirm the information on the tag they may seek the assistance of the control room. The inspector SHOULD NOT touch or manipulate equipment!

The inspector may consider periodically evaluating whether the licensee is following its processes for:

- Independent verification for the tagging and return to service of equipment;
- Physically disabling (safety) systems;
- Locking and periodic validation of system configuration;
- Verifying the alignment of equipment;
- Ensuring alternate pressure relief methods are available if relief valves are taken OOS.

The information presented in section 5.6.5 is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.6.6 Equipment environmental qualification inspection

There are a variety of operating environments at an NPP. These environments may involve areas of high humidity, extreme temperatures (hot and cold), submergence in liquids and high radiation areas. Other external factors such as flooding, seismic and wind loading are also environmental qualification (EQ) concerns. Most EQ involves electrical and digital I&C equipment; however, the qualification of other equipment (e.g., corrosion protection or degradation of rubber and plastic parts of SSCs) are normally included.

Specific inspections of EQ are normally performed by specialized inspectors; however, other inspectors may consider periodically assessing whether the licensee is following its EQ programme during system walkdown and specific inspections. If concerns are identified the inspector normally consults with a specialist.

5.6.7 Freeze seals

Freeze seals are used to isolate a section of piping for maintenance and to make modifications when there are no isolation valves that can perform the function. Freeze seals are normally established by wrapping the piping in a jacket that is cooled by liquid nitrogen and freezing water in the pipe to form an ice plug and isolate an area. Improper use of a freeze seal can weaken or damage the piping. When the licensee is using a freeze seal the inspector may consider assessing whether the licensee has considered the following items in establishing procedures and controls:

- Maintenance procedures ensure that an adequate supply of liquid nitrogen is available prior to commencing the freeze seal operation;
- Personnel are trained in the filling of nitrogen bottles;
- Freeze plug installation and maintenance will be performed by plant personnel who have been trained on freeze plug installation and maintenance techniques and procedures;
- The licensee has a documented contingency programme with implementing procedures to use in the event that a freeze plug fails;
- Freeze seals are normally not performed within some minimum distance (e.g., a minimum of 3 pipe diameters) from piping discontinuities;
- Freeze seals should not be placed over weld material unless properly evaluated;
- Freeze plug jacket temperature will be monitored to ensure that liquid nitrogen flow is maintained;
- Provide adequate ventilation to assure adequate circulation of volatile coolants;
- Adequate measures have been taken to protect electrical equipment and other systems whose operation could be impacted by a failure of the freeze plug;
- Planning and supervision of freeze seal operations needs to be performed by qualified and experienced personnel. In many cases, contractors with special expertise and experience in performing freeze seal operations will be used. A more in-depth inspection may be warranted if a recognized specialist in the area of freeze sealing is not being used;
- Planning for freeze seal operations includes consideration for the potential for causing structural damage to the piping based on the evaluation of a qualified engineer.

5.6.8 Concealed and underground piping

Undetected leakage from buried and underground pipes and tanks, caused by corrosion or mechanical damage, may result in groundwater contamination incidents. To assess the potential for such leakage the inspector may consider asking the following:

- Does the licensee inspect for degradation?
- Does the piping use lining?

- Does the piping have corrosion protection (e.g. cathodic protection)?
- Does the licensee monitor ground water to identified contamination from leaks?
- Are there stagnant flow locations in underground piping?
- Does the licensee perform chemistry sampling?

5.6.9 Heavy loads

The movement of heavy loads in an NPP may introduce both industrial and radiological hazards. Nuclear power plants use numerous cranes and hoists for a wide variety of heavy lifting tasks. Some of the cranes used are the polar crane in primary containment, the fuel building crane, and the turbine building crane. The concern is that if a heavy load is dropped, it could impact the fuel or safety related equipment. This could result in fuel damage, an offsite release, loss of decay heat removal capability, or loss of essential electrical power supplies.

The following failures in rigging, lifting, and material handling operations continue to occur:

- Policies and procedures for rigging, lifting, and material handling lack the detail that formally defines roles and responsibilities, provides technical and engineering guidance, and establishes safe working practices and standards;
- Personnel lack knowledge and proficiency in the use of rigging, lifting, and material handling equipment;
- The inspection, maintenance, storage, and control of rigging and lifting equipment are insufficient and defective equipment is not removed from service;
- Workers employ inappropriate practices while working with rigging and lifting equipment and moving loads. Workers frequently do not recognise potential and actual hazards;
- Management and supervisory oversight of plant and supplemental personnel performing rigging and lifting activities and moving loads is ineffective in identifying and correcting safety hazards.

During the inspection of heavy load movements, the inspector assesses whether the licensee has:

- Evaluated the pathway (safe load path) to ensure that the heavy load will not affect safety related SSCs;
- Developed contingency plans if the crane malfunctions during the lift;
- Evaluated the transportation path to ensure it does not pass over safety related piping or impact or damage other piping;
- Verified all the crane's protective features are working properly (limit switches, load cell);
- Adequately inspected and tested the crane and support equipment;
- Authorized personnel operating the crane and performing support functions;
- Adequate communication between the operator and flagman;
- "Verified that the crane or lifting device is rated above the weight of the load being lifted" [7].

5.6.10 Welds

The inspection of welding operations is normally performed by specialized inspectors. However, while inspections plant modifications and maintenance the inspector may consider:

- Checking for proper use of welding material and/or welding technique;
- Verify the handling of filler material:
    - account for how much filler material is used;
    - storage of filler material (tracking, temperature, humidity);
    - filler material is inspected before it is used.
- Verifying the qualification of welders;

- Determine approved welding procedures are being used;
- Verify the control of welding material and storage;
- Verify the control of welding environment (temperature, humidity);
- Verify that the non-destructive examination (NDE) performed to verify the integrity of the weld is appropriate for the application and the NDE personnel are qualified

5.6.11 Painting

Painting fumes could have a detrimental impact on the charcoal filters of any emergency filtration system such as the standby gas treatment system in a boiling water reactor. If these systems are in operation during or soon after a painting activity, the charcoal filters may be rendered inoperable in a very short period of time, effectively rendering the entire safety related system inoperable. In addition, inspectors need to:

- Be observant of painting activities around safety related equipment because paint spatter could render the equipment inoperable;
- Consider whether the painting will mask an issue;
- Verify that vent holes on pump casings and oil reservoirs have not been painted over, affecting equipment performance;
- Verify that painting in the vicinity of moving equipment, such as emergency diesel generator fuel racks, does not inadvertently lock up the fuel racks, preventing the diesel from attaining rated speed;
- Confirm that painting activities are not being performed in conjunction with emergency filtration system testing or operations. If they are, confirm that the licensee has evaluated the potential effect of the fumes on the charcoal filters.

The information presented in section 5.6.11 is closely aligned with the NRC Inspector Field Observation Best Practices [7].

5.6.12 Coatings

Coatings are normally used in NPPs to protect surfaces from adverse environments. To ensure proper protection of SSCs, coatings must be used in appropriate environments and applied using the vendor's specifications. Instances have occurred at NPPs were the misapplication or use in an inappropriate environment has resulted in unanticipated corrosion or created explosive environments (for example, when a zinc-based coating is used in a boric acid environment it may produce explosive levels of hydrogen).

Coatings being used on safety related equipment must appropriate for the application and been applied in accordance with vendor requirements. Coatings should not be flaking or delaminating.

5.6.13 Barriers and penetration seals

Nuclear power plants implement a variety of barriers and penetration seals to prevent the spread of fires, internal and external flooding and gases. During plant walkdowns inspectors may want to observe whether:

- Fire, HELB, and ventilation boundary doors are in satisfactory condition (close fully, latches functional, labelled properly, and not obstructed);
- Fire barriers properly installed and intact;
- Electrical penetration seals are in place with no visible signs of degradation;
- Ventilation fire isolation dampers are in good physical condition with fusible links installed;
- Fire proofing is uniformly applied with no bare spots;
- Water tight door seals and closing mechanisms are in good working order;
- Flood seals are intact with no signs of degradation;
- How does the licensee maintain configuration control of penetration seals?

5.6.14 Chlorides - tape and markings containing chlorides

"Although seemingly harmless, tape or markings on stainless steel piping can cause transgranular stress corrosion cracking as a result of the leeching of chlorides and can result in piping failure. Inspectors need to consider tape or markings on stainless steel piping and report observations to licensee personnel" [7].

5.6.15 Emergency diesel generators

Diesel generators are commonly used as the source for safety related emergency electrical power. Emergency diesel generators (EDGs) are highly reliable and can quickly provide power to safety related equipment if there is a loss of normal and backup power supplies. An EDG is generally expected to continuously provide electrical power in the event of a sustained loss of normal power concurrent with a loss of coolant accident (LOCA). However, the earthquake and subsequent tsunami at the Fukushima Daiichi NPPs demonstrated that a sustained loss of electrical power without a LOCA can have catastrophic results [8].

When performing a walkdown/inspection, the inspector needs to consider whether the EDG is capable of performing its safety related function. This assessment includes the diesel engine and generator as well as all of the support systems. Some examples of support systems include, but are not limited to:

- Fuel supply and storage;
- Cooling systems;
- Starting system (air or electrical);
- Lubricating oil;
- Ventilation;
- EDG output circuit breaker.

The inspection may be performed with the EDG in standby or in operation. If the EDG is in operation, the inspector must use the appropriate PPE. During the inspection, the inspector assesses whether the licensee has:

- Evaluated any leaks (oil, water, air, ...) to determine if the EDG is still capable of performing its safety function;
- Placed any OOS or information tags on the EDG;
- Verified that ventilation dampers are free of obstructions;
- Evaluated the impact of any scaffolding or equipment temporary stored in the EDG room.

While EGDs are the most commonly used safety related emergency AC power source, there are other types of sources including gas turbine generators, hydroelectric units, and small steam turbine generators. (This is not intended to be an exhaustive list and the specific type will vary depending on the NPP design.) There is an Inspection Guide in the Annex for emergency AC power sources which contains questions the inspector may find useful during walkdowns/ inspections. The Guide is not intended to replace the regulatory body's inspection procedures, nor should it be used as a comprehensive check list. The Guide is an additional tool for the inspector to use during assessment of the licensee's activities.

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[7] NUCLEAR REGULATORY COMMISSION, NRC Inspector Field Observation Best Practices, NUREG/BR-0363, Rev.1, Washington, DC (2009).

[8] INTERNATIONAL ATOMIC ENERGY AGENCY, Fukushima Daiichi Accident, IAEA Report by the Director General and the associated Technical Volumes, Vienna (2015).

ANNEX - INSPECTION GUIDES

The Inspection Guides in this annex contain questions which may be useful to inspectors during routine plant inspections. The Guides and questions presented are not intended to replace regulatory body inspection procedures or checklists: however, they may be used to augment or enhance them.

While the Guides are primarily intended to be used in the plant, there are additional questions included which may be checked after the plant inspection. These questions are also intended to be used as additional tools during inspections of SSCs.

GAUGES (TEMPERATURE, PRESSURE, FLOW, LEVEL)

Gauges (Temperature, Pressure, Flow, Level, etc.…)	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are the locations of the gauges useful to the operators for equipment operation?	
Is the gauge damaged, distorted or difficult to read?	
Are the needles off scale high (pegged) or off scale low (pegged)?	
Are the needles bent or otherwise in poor condition?	
Does the gauge appear to have been tampered with or vandalized? Is the security seal intact (if installed)?	
Does the gauge show any signs of leakage, especially at the fittings? Are there any radiological concerns because of the leakage?	
Does the gauge have labels indicating normal, abnormal, and dangerous operating ranges?	
Is there vibration or steady movement of the gauge?	
Are there indications of rubbing or vibration induced wear?	
Are there indications of abnormal displacement or bending on small bore tubing?	
Is the gauge labelled unambiguously? Is it clear which system, train, or unit applies to the gauge?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Are the range, accuracy, and graduations of the gauge consistent with the requirements of the procedures?	
Does the gauge require calibration? Is it within its required calibration frequency? Follow-up question: Does the gauge require routine maintenance and/or lubrication?	
Is the parameter value recorded on a log? (either paper or electronic) If recorded, is the data evaluated? (Who, When, Why, …)	
If there are indications of leakage, when was the last time the maintenance, surveillance, or other testing activity performed which could have identified the leakage?	
Are these ranges on the gauges consistent with operating procedures and the vendor's recommendations?	
Are the labels on the gauges controlled by a plant programme or procedure?	
Is there a remote indication of the same parameter that is on the local gauge? Is the remote value consistent with the local indication?	
Does the gauge initiate an automatic function or alarm? Is the alarm local or remote (or both)? How often is it tested?	

Gauges (Temperature, Pressure, Flow, Level, etc.…)	
Detailed Questions	Comments
What operator actions (if any) are expected to be taken if the parameter is beyond its normal operating range?	
If there is vibration or steady movement of the gauge, has that been evaluated and is that acceptable?	
Could the operation of a gauge be affected by the environment? (e.g., Is it too cold? Is it too humid? Is there too much radiation? Is there too much vibration?)	

VALVES AND SAFETY / RELIEF VALVES

Valves and Safety / Relief Valves	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Does the valve have a label or Identification tag? Is it clear which system, train, or unit applies to the valve?	
Is there a sign warning personnel that the valve has the potential for valve movement?	
Are there posted procedures for manual actions?	
Are there any visible or posted operator aids?	
Are tools and equipment needed for manual operation located nearby?	
Is there sufficient access to locally operate the valve? Is a reach rod to locally operate the valve? Is there a ladder installed or available nearby to help reach the valve?	
Is there local valve position indication?	
Are there indications of leakage (water, air, oils, boric acid, packing, etc.)? Note that rust coloured residue may indicate corrosion. Is the leakage properly controlled?	
Is the leakage potentially contaminated?	
Is there evidence that a device such as a hammer has been used to **free** a check valve or **reseat** a relief valve?	
Are valves (especially check valves) in the correct orientation to perform their intended function?	
Are the valve markings (bridgewall markings) consistent with the direction of flow?	
Are there indications that the valves have been used to climb instead of a ladder or scaffolding? (foot prints, worn paint, crushed insulation, etc...)	
Is a load such as shielding or scaffolding being supported by a valve?	
Is the release path for a safety/relief valve unobstructed? Is the release path free of equipment that may be damaged by the release? Is the release path discharge piping at least as large as the relief valve outlet size? (The concern here is that if the discharge piping is too small, the valve will not be able to reduce system pressure quickly enough to prevent damage to the system.	
Does the safety/relief valve appear to be leaking? Is it warm or hot near the discharge piping?	
Does the safety/relief valve appear to be gagged closed?	

Valves and Safety / Relief Valves	
Detailed Questions	Comments
Does the safety/relief valve have a calibration tag and is it within calibration?	
Do the visible electrical connections on the MOV appear properly attached and not visibly loose or damaged?	
Are the MOV power cables properly supported?	
Is there any discoloration or evidence of heat on the MOV?	
Is there any evidence of leakage from the MOV (oil, grease, lubrication)?	
Are there indications of rubbing or vibration induced wear?	
Are there written instructions for local valve operation?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Is the identification tag or label consistent with plant drawings and procedures?	
If the valve has a locking device installed, how is the locking device removed? Who has the keys to remove the device and under what circumstances would it be removed?	
Does the valve have an automatic actuation signal? If yes, do the licensee's procedures require a sign to warn personnel of the potential valve movement?	
Are there manual actions required to back up and/or correct a degraded automatic function?	
If there are posted procedures for manual actions, are they the current revision?	
If there are visible or posted operator aids, do they match the licensee's procedures?	
If there is a remote valve position indication, is there consistent with the local indication?	
If there is evidence that a device such as a hammer has been used to "free" a check valve or "reseat" a relief valve, has using the device been approved?	
If there is indication that a load such as radiation shielding or scaffolding has been supported by a valve, has the licensee analysed and authorized the load?	
If a safety/relief valve is gagged closed, has the licensee evaluated and approved it? If a safety/relief valve is gagged closed, how is overpressure protection being provided?	
Is the safety/relief valve name plate data consistent with the system operating and design pressure?	
If the safety/relief valve requires calibration, is it within its required frequency?	

Valves and Safety / Relief Valves	
Detailed Questions	Comments
For air operated valves (AOV), is a backup system required if the normal supply is disrupted? How often is it tested?	
For AOVs, the loss of air will cause the valve to fail open, fail closed, or fail in the same position. Is the loss of air position the safe position?	
If there are loose nuts or bolts on the valve, what are the torque requirements in the maintenance procedures or vendor manual? (Note - this may lead to questions regarding maintenance training, equipment calibration, and general skill of the maintenance staff.)	
If there are written instructions for local valve operation, are the instructions consistent with: • The plant operating procedures? • The current revision of the plant procedures? • Industry operating experience? • Vendor/manufacturer recommendations?	
Is local valve operation included in the initial operator training program? Is it included in the continuing operator training program?	
Has the valve been modified or otherwise changed since it was installed? If yes, have drawings, procedures, and other documents been updated?	

BOTTLE OIL RESERVOIRS / SIGHT GLASS

Bottle Oil Reservoirs / Sight Glass	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Is the oil level within the required operating band? (Be aware that visible level in the bottle or sight glass may not tell the whole story.)	
Are there leaks/drips from the reservoir? If yes, how is the oil contained?	
Does the leaking oil present a new fire hazard?	
Are there indications of rubbing or vibration induced wear on the components?	
Is the equipment labelled unambiguously? Is it clear which system, train, or unit applies to the equipment?	
Are there indications of abnormal displacement or bending on small bore tubing?	
Does the oil appear discolored? (Note that different oils have different colors.)	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Are there alternate methods to determine oil level?	
If the level is outside of the required band, what action is the operator required to take?	
Is the oil level recorded? Is the data trended and evaluated?	
When oil is added to the reservoir, how does the licensee ensure the correct oil is added?	
Does the station routinely sample the oil? Does the station analyse and trend the sample results? What is the basis of the sampling frequency?	
Is the frequency of the sample sufficient to detect degradation before failure? Is the frequency of the sample consistent with the vendor's recommendations?	
Have the operators been trained on the potential problems associated with bottle oil reservoirs?	

INSTRUMENTATION

Instrumentation	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are there indications of rubbing or vibration induced wear?	
Are there indications of abnormal displacement or bending on small bore tubing?	
Do the installed instruments appear to be functional and in good repair? Any signs of tampering?	
Is the equipment labelled correctly and readable? Is it clear which system, train, or unit applies to the equipment?	
Is there any sign of leakage?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Are the parameters needed to safely operate the plant and to respond to abnormal conditions being used as inputs for protection and control systems?	
If local action is required for normal (or abnormal) operations, are the local alarms and indications sufficient for the operator to safely complete the task?	
Are the range, accuracy, and set point of instrumentation adequate for the intended function?	
Are the specified surveillance and calibrations of instrumentation acceptable?	

CIRCUIT BREAKERS, MOTOR CONTROL CENTERS, CABINETS, AND FUSES

Circuit Breakers, Cabinets, and Fuses	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are spare breakers that are stored outside of a cubicle properly restrained?	
Are electrical cabinets, breaker cubicles, and junction box covers closed and secured appropriately? (Possibly a high energy line break (HELB) or seismic concern.)	
Do the indicator lights on panels, breakers, cabinets, and other equipment appear to be functional and in good working order?	
Is the equipment labelled unambiguously? Is it clear which system, train, or unit applies to the equipment?	
Are there warning signs on motor control centers (MCCs) and cabinets that have relays mounted on the access doors?	
Do the circuit breakers or MCCs show signs of overheating such as discoloration, cracking, or odour?	
Are the breaker cabinet and MCC vents free of obstructions and debris?	
Do the breaker cabinets and MCCs in HELB areas have appropriate spray shields and moisture protection?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Is the breaker control logic adequate to fulfill the functional requirements?	
Is the short circuit rating in accordance with the short circuit duty?	
Are the breakers and fuses properly rated for the load current capability? (DC circuits may have different requirements.)	
Are the circuit breakers that are not racked in, (i.e., an intermediate position) still considered seismically qualified for Class 1E switchgear? Does licensee have a programme to evaluate the seismic qualification for breakers that are not fully racked in?	
How does the licensee guard against human performance errors (wrong unit/wrong train)?	
Is the lubrication programme for the circuit breakers and MCCs consistent with the vendors' recommendations?	

Circuit Breakers, Cabinets, and Fuses	
Detailed Questions	Comments
Is the circuit breaker mechanical linkage alignment procedure consistent with the vendor's recommendations?	
Are sensitive relays and circuits protected from spurious actuation due to vibration, inadvertent bumps, radio signals, etc.?	
If breaker cabinets and MCCs are in HELB areas, are they environmentally qualified?	

ELECTRICAL CABLES, JUNCTION BOXES, AND CONDUIT

Electrical Cables, Junction Boxes, and Conduit	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Do temporary power cables appear to be in good condition? Are there indications of rubbing or vibration induced wear?	
Are Ground Fault Current Interrupter (GFCI) devices being used appropriately?	
Are temporary electrical cables or extension cords draped over or tie wrapped to safety related conduits or near safety related cable trays?	
Is there a tag or label identifying the organization responsible for the temporary cable?	
Are conduit connections properly attached and not visibly loose?	
Do the conduit seals appear to be properly installed and in good working condition? If not, this could be a fire, EQ, or HELB concern.	
Is the conduit properly supported and shows no signs of corrosion or other damage?	
Does the conduit and exposed wiring show signs of overheating such as discoloration, cracking, or odour?	
Are electrical cabinets, breaker cubicles, and junction box covers closed and secured appropriately? (Possibly an HELB or seismic concern.)	
Do temporary electrical cables that prevent fire doors, HELB doors, flood protection doors, etc., from closing have the required impairment permits?	
Is lighting that is installed on chains or other devices allowed to swing freely?	
Is lighting that is installed using a restraining chain or rod to prevent motion in one direction near safety related equipment?	
Is conduit that is installed below grade level elevation properly sealed?	
Are underground cables maintained in a dry environment?	
Are there any normally submerged electrical cables, conduit, or junction boxes?	
Are there loose nuts or bolts on any components?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
If lighting is installed on chains or other devices that allow it to swing freely, can it adversely impact safety related equipment during a seismic event?	

Electrical Cables, Junction Boxes, and Conduit	
Detailed Questions	Comments
If lighting is installed using a restraining chain or rod to prevent motion in one direction near safety related equipment, is It properly installed?	
If conduit is installed below grade level elevation, how often are the seals checked?	
If there are underground cables, how often are they checked to ensure a dry environment is maintained?	
If there are normally submerged electrical cables, conduit, or junction boxes, how often are they checked for dryness?	
Does the licensee have a programme to examine cables, conduit, or junction boxes that are found submerged?	
If there are loose nuts or bolts on any components, what are the torque requirements in the maintenance procedures or vendor manual? (This may lead to questions regarding maintenance training, equipment calibration, and general skill of the craft.)	
How does the licensee guard against human performance errors (wrong unit/wrong train)?	

FASTENERS, BOLTS, SUPPORTS, PIPE CLAMPS, AND SNUBBERS

Fasteners, Bolts, Supports, Pipe Clamps, and Snubbers.	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are there loose or missing fasteners (nuts, bolts, screws)? (Note that some snubbers and restraints are not bolted tightly to allow for some freedom of motion, but are provided with lock nuts, cotter pins or other devices secure the connections.)	
Are there loose nuts or bolts on the equipment?	
For nut and bolt type connections, is the nut fully threaded on the bolt or stud?	
Do the fastening devices show signs of abnormal wear, corrosion, or other visible degradation?	
Are cotter pins and other position locking devices (such as roll pins, safety wire, or lock nuts) properly installed?	
Do hydraulic snubbers show indications of leakage?	
Are the fluid reservoirs on hydraulic snubbers filled to the proper level?	
Do snubber assemblies (supports, pipe, and pipe clamps) show signs of deformation?	
Has an additional load (e.g., radiation shielding, scaffolding) been attached to the support?	
Are there indications that the supports have been used for climbing instead of using a ladder or scaffolding? (foot prints, worn paint, crushed insulation, etc...)	
Are there indications (marks or welding) that the fastener is the wrong size or has been modified?	
Are fasteners symmetric?	
Are there indications of boric acid leaks? Rust colored residue may indicate corrosion.	
Are there indications of rubbing or vibration induced wear?	
Is the pipe support shoe free to move?	
Is the pipe clamp / support properly aligned? Is there any indication of misalignment?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
If there are loose nuts or bolts on the components, what are the torque requirements in the maintenance procedures or vendor manual? (Note that this may lead to questions regarding maintenance training, equipment calibration, and general skill of the craft.)	
For nut and bolt type connections, if the nut is not fully threaded on the bolt or stud, is it required to be fully threaded?	
If snubber assemblies (supports, pipe, and pipe clamps) show signs of deformation, is that an indication of water hammer or overload condition?	
If the locking pins are removed on spring can type supports, ask why the pins were removed.	
For spring can type supports, ask why the locking pins in place or why they are removed?	

Fasteners, Bolts, Supports, Pipe Clamps, and Snubbers.	
Detailed Questions	Comments
If there is an indication that an additional load (e.g., radiation shielding, scaffolding) been attached to the support, has the station completed the required analysis?	
Do the as built drawings match the configuration in the plant?	
Are there additional supports or supports in locations that differ from the drawings? This may be an indication of previous water hammer events.	
If fasteners are not symmetric, should they be?	
If a pipe support shoe free to move, is it required to be centred?	

SCAFFOLDING AND LADDERS

Scaffolding and Ladders	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Does the scaffolding or ladder block or impede: ▪ Operator actions or emergency routes? ▪ Access to emergency or Safe Shutdown equipment or control locations? ▪ Access to, or functioning of, fire protection equipment? ▪ Security measures (line of sight, response, etc.)? ▪ Operation of safety related ventilation systems?	
Is the scaffolding or ladder connected to, or in contact with, safety related instruments, piping, valves, pumps, or support equipment?	
Does the scaffolding or ladder allow access to radiation areas without proper signs and controls?	
Are personnel on the scaffolding or ladder using the proper safety equipment?	
Is there a tag or label identifying the organization responsible for the scaffolding?	
Does the scaffolding have an approval tag or label?	
Has the scaffolding exceeded its time limitations?	
Does the scaffolding interfere with (or shadow) the overhead sprinklers? (i.e., the scaffolding should not block sprinkler water from reaching potentially combustible hazards below or adjacent to the scaffolding.)	
Does the scaffolding have toe boards (if required) to prevent tools and other heavy objects from accidently being kicked off the scaffolding onto someone below?	
Is there any vibration? If yes, does the vibration affect the stability of the scaffolding or ladder?	
Are there indications of rubbing or vibration induced wear?	
Are trip and fall hazards clearly marked?	
Are bump hazards such as low hanging pipes clearly marked?	
Are stairway and platform hand rails affixed securely?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Does the scaffolding or ladder comply with the licensee's requirements?	
Does the scaffolding or ladder change the fire loading limits of the area?	

HOUSEKEEPING AND GENERAL MATERIAL CONDITION

Housekeeping and General Material Condition	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are licensee's standards being met? (If not, take pictures.)	
Are equipment and tools left in work areas stored in an orderly manner?	
Is the plant free of debris, trash, etc..?	
Are there indications of fluid or air leaks (such as valve packing, body to bonnet, or seals)?	
Are there indications of boric acid leakage or build up? Note that rust coloured residue may indicate corrosion.	
Are there abnormal vibrations, noises, discoloration, or odours in a room or space?	
Does material such as, scaffolding and tool boxes that is staged for other activities interfere with plant operations, safe shutdown, fire protection, security, etc..?,	
Is the paint and coatings on floors, piping, equipment, cabinets, doors, and enclosures in good condition?	
Are concrete floors and walls free of major cracks or other degradation?	
Are paint and coatings on floors, piping, equipment, cabinets, doors, and enclosures in good condition?	
Are painting activities being performed in conjunction with emergency filtration system testing or operations?	
Are painting activities being performed near safety related equipment?	
Are there markings or tape on stainless steel piping?	
Are installed communications devices in good repair (e.g., wiring not frayed or broken, handsets intact, and a dial tone present)?	
Is insulation properly placed and in good repair (e.g., not crushed, dislodged, wet, or otherwise less than fully serviceable)?	
Are installed plant components being used as temporary supports or restraints?	
Are there indications of rubbing or vibration induced wear on supports or piping?	
Does small bore piping (such as instrumentation, vents, or drains) show signs of abnormal displacement or bending?	
Do battery operated emergency lights appear to be in good working condition? Are there indications of overheating, battery acid leaks, or faulty charging circuits?	
Is normal lighting adequate to safely perform routine activities including ingress and egress?	
Are emergency flashlights easily available?	
Are trip and fall hazards clearly marked? Are bump hazards such as low hanging pipes clearly marked and protected?	
Are stairway and platform hand rails affixed securely?	

Housekeeping and General Material Condition	
Detailed Questions	Comments
Are wet floors or standing water puddles clearly marked?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Are temporary storage areas for equipment such as hoses, sump pumps, cables, barriers, or shielding controlled by procedure or by approved temporary modification?	
If temporary storage areas are being used, has the fire loading for the area changed?	
If painting activities are being performed in conjunction with emergency filtration system testing or operations, has the licensee evaluated the potential effect of the paint fumes on the charcoal filters?	
If painting activities are being performed near safety related equipment, has the licensee evaluated the potential effect of the paint fumes on the operation of the equipment?	
If there are markings or tape on stainless steel piping, has the tape been evaluated for chlorides?	
Are emergency lighting units available where needed to perform critical tasks and to provide safe ingress and egress? Are the lights properly aimed?	
If there are wet floors or standing water puddles, is the fluid a radiological or health hazard?	
Do combustible materials in the area meet the requirements specified by Control of Transient Combustibles procedure?	
Are transient load restrictions as specified by Housekeeping Procedure being followed?	
Is temporary equipment in the area (such as hoses, sump pumps, cables, barriers, or shielding) being controlled by procedure or by approved temporary modification?	

FOREIGN MATERIAL EXCLUSION

Foreign Material Exclusion (FME)	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are openings in piping systems or components plugged or covered with a prefabricated FME device?	
If a system is open, is there evidence that controls are in place to prevent foreign material from entering a system?	
Does the refuelling floor and fuel handling building have well defined areas with strict FME controls around the spent fuel pool?	
Is the licensee using a control log to ensure appropriate FME controls are maintained?	
Do floor grates, drains, and drain covers have proper FME controls and are they secured in place?	
If floor drains are plugged, is there an alternate drain path?	
Is an FME monitor designated for a selected job?	
If an FME barrier is erected, does it display an FME placard?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Does the licensee have and follow a formal FME procedure?	
What provisions or processes are in place to routinely check the condition of drain plugs and covers?	
Are the station and contractor personnel trained to understand FME principles?	
How are corrective action initiated if FME requirements have not been met?	

PUMPS

Pumps	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are there indications of leaks (oil, air, water, etc...)? Any pump seal leaks?	
Is there any abnormal vibration, noise, discoloration, or odour?	
Are there indications of rubbing or vibration induced wear?	
Is the oil level indication within the required operating band? (Be aware that visible level may not tell the whole story.)	
Is the coupling between the pump and the motor, turbine, etc.., properly aligned? Do the coupling inserts appear excessively worn?	
Is there seal leakage? Is the leak off controlled? Is it contaminated?	
Are seal spray shields properly installed?	
Does the seal leakage spray on adjacent electrical components or bearing housing?	
Are there posted procedures for manual actions? Are there any operator aids?	
Are the values for the local indications reasonable based on your knowledge of the system?	
Is the shaft in a standby pump rotating? (This may be an indication of check valve leakage or improper valve lineup.)	
Have the vent holes on pump casings and oil reservoirs been painted over?	
Are there loose nuts or bolts on the pump?	
Is the equipment labelled unambiguously? Is it clear which system, train, or unit applies to the equipment?	
Are there indications of cavitation? Indications may include vibrations, noise, rapid changes in flow and pressure, etc.…	
Are the pump's safety / relief valves leaking? Is the release path unobstructed? Is the release path free of equipment that may be damaged by the release?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
If there is seal leakage, is it within the vendor's specifications? Is it being trended?	
If there are posted procedures for manual actions and/or operator aids, are the procedures and/or aids the most recent revision?	
Are the values for local indications of pressure, temperature, flow, etc.…consistent with MCR or other remote indications?	
Does the licensee have a programme to equalize run time on redundant equipment? Is it consistent with the vendor's recommendations?	

Pumps	
Detailed Questions	Comments
If there are loose nuts or bolts on the pump, what are the torque requirements in the maintenance procedures or vendor manual? This may lead to questions regarding maintenance training, equipment calibration, and general skill of the craft.	
Does the name plant data (flow, pressure, etc..) match the intended use of the pump?	
If there are indications of cavitation, is the net positive suction head adequate? Is the valve line up to the suction of the pump correct?	
How does the licensee ensure adequate minimum recirculation flow? Is there a time limit at the minimum flow?	
Do the vendor data and specifications support sustained operations at low flow rates?	
Is the pump free of gas voids? What processes or procedures were used to determine there is no gas accumulation that could air bind (or steam bind) the pump?	
How are the bearings and seal cooling systems evaluated to ensure acceptable cooling during minimum flow conditions? During design bases accident conditions?	

MOTORS

Motors	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Is there any abnormal vibration, noise, discoloration, heat, or odour?	
Are there indications of rubbing or vibration induced wear?	
Are the motor vents free of obstructions and debris?	
Is the coupling between the motor and pump, fan, compressor, etc.., properly aligned? Do the coupling inserts appear excessively worn?	
Is the oil level within the required operating band? (Be aware that visible level may not tell the whole story.)	
Is there discoloration of the electrical junction box? (This is a potential indication of high electrical resistance connection.)	
Do the visible electrical connections appear properly attached and not visibly loose? (Do not touch the connections.)	
Are the power cables properly supported? (Do not touch the power cables.)	
Are there loose nuts or bolts on the motor?	
Is the equipment labelled unambiguously? Is it clear which system, train, or unit applies to the equipment?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
For DC motors, does the local environment present a contaminant for the carbon brushes? (Examples include high humidity, airborne dust or dirt, water or oil mist, paint or chemical vapours, etc.	
Does the licensee have a programme to equalize run time on redundant equipment? Is it consistent with the vendor's recommendations?	
If there are loose nuts or bolts on the motor, what are the torque requirements in the maintenance procedures or vendor manual? This may lead to questions regarding maintenance training, equipment calibration, and general skill of the craft.	
Does the name plant data (voltage, frequency, KW/KVA, etc..) match the intended use of the motor?	
How does the license monitor for degraded conditions such as insulation resistance, running currents, starting currents, temperature, and vibrations? Is that monitoring consistent with the vendor's recommendations?	
Does the licensee evaluate starting current (in rush) compared to the running current and fully loaded current?	
Has the motor been analyzed to function properly under the expected lowest and highest voltages during both normal and accident conditions?	
Has the motor been analyzed for its electrical protection requirements?	

SYSTEMS AND TRAINS

Systems and Trains	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are installed instruments (such as pressure, temperature, flow gauges, etc…) functional and in good repair?	
Are there indications of abnormal displacement or bending on small bore piping such as instrumentation, vents, or drains?	
Are there posted procedures or operator aids for manual actions?	
Are tools and equipment needed for manual operation located nearby? Are emergency flashlights easily available?	
Is the shaft in a standby pump rotating? (This may be an indication of check valve leakage or improper valve lineup.)	
Are there any danger tags, caution tags, or information tags on the safety related equipment (and support equipment)?	
Are any safety / relief valves leaking? Is the release path unobstructed? Is the release path free of equipment that may be damaged by the release?	
For systems with redundant heat exchangers (HXs), are flow rates, temperatures, pressures, etc… consistent?	
Are there any temporary changes or temporary modifications?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Is the system or train capable of performing its safety related function?	
Can the support systems perform their safety related functions?	
If one train is inoperable or degraded, is the other train capable of performing its safety function?	
Does the as built configuration match the analysed design and the drawings?	
Is the system filled, vented, and free of voids? What processes or procedures were used to determine the system was free of voids?	
If there are any temporary changes or temporary modifications: • Have they been analysed? • How long will they remain in place? • Are there new operator actions associated with the modification?	

Systems and Trains	
Detailed Questions	Comments
If the system has time critical operator actions: • Has the licensee performed a verification and validation of the action? • Have staff members who are required to perform the action been trained to perform it? • Is the validation realistic? • Do the calculations support the time requirements?	
Is the licensee relying on compensatory measures, temporary modifications, or operator work arounds to compensate for degraded conditions? (e.g. jumpers to bypass nuisance alarms.)	
Are water sources and alternate water sources available and properly lined up? If the system has an automatic swap over, what were the results of the last test? Are the set points consistent with the safety analysis?	
How does the licensee guard against human performance errors (including wrong unit/wrong train)?	
Is the system/train free of gas voids? What processes or procedures were used to determine there is no gas accumulation that could air bind (or steam bind) the pump?	
How does the licensee ensure adequate minimum recirculation flow? Is there a time limit at the minimum flow?	
Do the vendor data and specifications support sustained operations at low flow rates?	
Has the electrical loads been analyzed to function properly under the expected lowest and highest voltages during both normal and accident conditions?	
Does the licensee evaluate starting current (in rush) compared to the running current and fully loaded current?	
Have loads been analyzed for their electrical protection requirements?	
If there are posted procedures or operator aids for manual actions, are they the current revision? Are they useful?	
If there are loose nuts or bolts on components, what are the torque requirements in the maintenance procedures or vendor manual? (This may lead to questions regarding maintenance training, equipment calibration, and general skill of the craft.)	
If there are any danger tags, caution tags, or information tags on the safety related equipment (and support equipment), what is the purpose of the tag? Is the system or train still capable of performing its safety related function?	
How is the performance of systems with redundant heat exchangers (HXs) monitored and evaluated?	

Systems and Trains	
Detailed Questions	Comments
If a system that has redundant HXs and the HX endbells are not in the same orientation, is the performance of the two HXs the same?	
Are any HXs identified with degraded performance? If yes, what is the licensee’s threshold to declare that the HX can no longer perform its intended function? If yes, is the cause a leak, silting, biological growth, tube plugging, etc…?	

EMERGENCY AC POWER SOURCE

Emergency AC Power Source	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
If the emergency AC power source uses an air start system, is the system free of small air leaks? Are the exhaust ports for solenoid valves open and free of obstructions?	
Are there any temporary changes or temporary modifications?	
Are there posted procedures for manual actions? Are there any operator aids?	
Are tools and equipment needed for manual operation located nearby?	
Do the indicator lights on panels, cabinets, and other equipment appear to be functional and in good working order?	
Are there loose nuts or bolts on the equipment?	
Are there any leaks (oil, water, air…)?	
Are there any OOS tags or information tags?	
Are ventilation dampers free of obstructions?	
Is there any scaffolding or equipment temporarily stored in the emergency AC power source room?	
If the emergency AC power source is in standby, are the fluid system temperatures at their nominal values?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Are the emergency AC power sources capable of performing their safety related function?	
Are all the support systems capable of performing their safety related function?	
If there are any temporary changes or temporary modifications: • Have they been analysed? • How long will they remain in place? • Are there new operator actions associated with the modification?	
If there are posted procedures for manual actions or any operator aids, are they the current revision?	
If there are loose nuts or bolts on the equipment, what are the torque requirements in the maintenance procedures or vendor manual? This may lead to questions regarding maintenance training, equipment calibration, and general skill of the craft.	
Does the name plant data (voltage, frequency, kilowatts, kilovolt amperes, frequency, horse power, etc..) match the intended use of the generator and engine/prime mover?	
If an emergency AC power source is out of service, what steps has the licensee taken to protect the remaining sources of electrical power to the safety related systems?	
If a room is protected by a total flooding gaseous suppression system (such as CO_2), are the egress doors	

Emergency AC Power Source	
Detailed Questions	Comments
labelled to warn occupants of a possible system discharge?	
If there are leaks, have they been evaluated? Is the emergency AC power source still capable of performing its safety function?	
If there are OOS tags or information tags, is the emergency AC power source still capable of performing its safety function?	
If there is scaffolding or equipment temporarily stored in the emergency AC power source room, has the licensee evaluated how it affects the emergency AC power source's ability to perform its safety function?	

GENERAL PLANT AREAS

Plant Area	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are there any unauthorized/temporary/ duplicate markings on equipment?	
Is there any equipment without a permanent identification tag or label?	
Are the door locks and/or closing mechanisms working properly?	
Are communication links between local areas (or local control room) and MCR in good working order?	
Is there any deficient equipment without some sort of tag?	
Is there any foreign matter/debris in sumps?	
Are the doors to vital/safety related equipment and cabinets secured and locked?	
Does the security systems (such as card readers, locks, cameras, etc.) appear to be functioning and in good repair?	
Are licensee personnel and contractors in the areas properly using PPE? Is PPE readily available in the local areas?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
If required, is a negative pressure maintained in high radiation areas?	
If required, is positive pressure maintained in the MCR? If required, is a positive pressure maintained in the personnel access pathways to the nuclear instruments?	

FIRE PROTECTION

Fire Protection	
Detailed Questions	Comments
Questions to be Considered DURING the Walkdown or Plant Inspection.	
Are fire hoses and nozzles in good material condition?	
Is there a wire seal on the fire hose reel (to prevent it from unwinding)?	
Is there a spanner wrench in close proximity to the fire hose station (to aid in the operation of the isolation valve)?	
Are fire extinguishers accessible and ready to use?	
Are any fire doors permanently blocked open?	
Are any fire doors prevented from fully closing due to obstructions such as temporary electrical cords or water hoses?	
Are there any obvious hindrances or obstacles in an evacuation route?	
Are combustible materials stored in places not designated as combustible materials storage areas?	
Are any fire extinguishers empty or expired?	
Are sprinkler heads obstructed by equipment, scaffolding, or temporary modifications?	
If a jockey pump is used to maintain the fire protection water supply pressure, is system pressure steady or does the jockey pump cycle off/on repeatedly?	
Is any hot work (such as welding or grinding) being performed? Is there a hot work permit?	
Additional Questions to be Considered AFTER the Walkdown or Plant Inspection.	
Has the surveillance on the fire extinguishers been routinely performed?	
Is firefighting equipment available at designated areas? Is it properly secured?	
Are penetrations through fire walls sealed with the appropriate fire-retardant material?	
If hot work is being performed, is it being done in accordance with fire protection procedures (e.g., fire watch station, fire extinguisher, communication with MCR, etc.)?	
If a room is protected by a total flooding gaseous suppression system (such as CO_2), are the egress doors labelled to warn occupants of a possible system discharge?	
If a fire door is prevented from fully closing due to obstructions such as temporary electrical cords or water hoses, has the licensee posted the required impairment permit and taken the appropriate compensatory actions?	

ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
AOV	Air operated valve
ASME	American Society of Mechanical Engineers
CO_2	Carbon dioxide
EDG	Emergency Diesel Generator
EPD	Electronic personal dosimeter
EQ	Environmental Qualification
FME	Foreign material exclusion
FSAR	Final Safety Analysis Report
GFCI	Ground Fault Current Interrupter
HELB	High energy line break
HX	Heat exchanger
KSA	Knowledge, skills, and abilities
LOCA	Loss of coolant accident
MCC	Motor control centre
MCR	Main control room
MOV	Motor operated valve
NDE	Non-destructive examination
NEI	Nuclear Energy Institute
NPP	Nuclear power plant
OEF	Operating Experience Feedback
OOS	Out of service
PMT	Post maintenance test
PPE	Personal protective equipment
PSAR	Preliminary Safety Analysis Report
RWP	Radiation work permit
SSC	Structures, systems, and components
STAR	Stop, Think, Act, Review
UFSAR	Updated Final Safety Analysis Report

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