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International Atomic Energy Agency

Manual for IRS Coding

2022 Edition

Joint IAEA and OECD/NEA International Reporting System for Operating Experience (IRS)

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MANUAL FOR IRS CODING

The Agency’s Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is “to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world’’.

IAEA SERVICES SERIES No. 20 (Rev. 1)

MANUAL FOR IRS CODING

2022 EDITION

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FOREWORD

The fundamental objective of the International Reporting System for Operating Experience (IRS) is to contribute to improving the safety of commercial nuclear power plants worldwide. This objective can be achieved by providing timely and detailed information on lessons learned from designing, constructing, commissioning, operating and decommissioning experiences at the international level. Such information relates to all issues and events that are relevant to nuclear safety.

In 2010 the IAEA and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA) published IRS Guidelines (IAEA Services Series No. 19), which was revised in 2022 (IAEA Services Series No. 19 (Rev. 1)).

In 2011 the IAEA and the OECD/NEA published the Manual for IRS Coding (IAEA Services Series No. 20). This revised publication is intended as a companion to IRS Guidelines and supersedes all previous versions. It describes the individual coding fields in detail and their proper application in the preparation of IRS reports.

This publication is the outcome of consultancy meetings held in Vienna in May 2019 and November 2019. It is closely aligned with IAEA Safety Standards Series No. SSG-50, Operating Experience Feedback for Nuclear Installations. The IAEA officers responsible for this publication were H. Morgan and D. Zahradka of the Division of Nuclear Installation Safety.

EDITORIAL NOTE

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1. INTRODUCTION

The International Reporting System for Operating Experience (IRS) is jointly operated by the IAEA and the Organisation for Economic Co-operation and Development Nuclear Energy Agency (OECD/NEA).

In 2010, the IAEA and OECD/NEA jointly issued the IRS guidelines [1], which described the reporting system and related processes and gave users the elements necessary to enable them to produce high quality reports while retaining the effectiveness of the system expected by the Member States. In 2011, a companion manual for IRS coding [2] was also issued.

In 2019, the scope of IRS database was expanded to include the events that were previously reported though the Construction Experience (ConEx) programme of the OECD/NEA. All new construction experience reports will now be reported through the Web Based IRS application. As such, the IRS guidelines were revised to incorporate this change and to document changes to the process of event reporting that had occurred in the almost ten years since the original issuance of the document.

The purpose of this revised manual for IRS coding is to provide guidance specifically related to the coding of IRS reports to ensure the reports provided by the IAEA Member States are coded in a uniform and consistent manner. This coding manual supports the revised IRS guidelines by enabling users to achieve a high level of quality and consistency in their IRS reports. Consistency and high quality in the IRS reports allow all IRS stakeholders to search and retrieve specific event/information with ease. In addition, well-structured reports also assist with the efficient management of the IRS database. This manual is closely aligned with the recommendations provided in IAEA Safety Standards Series No. SSG-50, Operating Experience Feedback for Nuclear Installations.

For ease of understanding in the use of this manual for IRS coding, the terms ‘events’, or ‘events/information’ are intended to mean any events, issues, and relevant operating experience, such as good practices, lessons learned, or other findings.

This coding manual gives specific guidance on the application of each of the IRS codes, with examples where deemed necessary, of when and how these codes are to be applied. As this reporting system is owned by the Member States, this manual has been developed and approved by the IRS National Coordinators with the assistance of the IAEA and NEA Secretariats

2. OUTLINE AND EXPLANATION OF THE INDIVIDUAL CODING FIELDS

The following coding fields are used when preparing IRS reports:

1. Reporting categories;
2. Plant status prior to the event;
3. Failed/affected systems;
4. Failed/affected components;
5. Cause of the event;
6. Effects on operation;
7. Characteristics of the event/information;
8. Nature of failure or error;
9. Recovery actions.

This section provides explanation and information on each coding field and the individual codes used in each field. Where deemed necessary, examples of how the individual codes need to be applied are given in Section 3. It is possible that more than one individual code in each field may be applied to a single IRS report. For the completion of all IRS reports to be submitted, at least one entry is desirable for each coding field.

A report may be prepared not only because an event has occurred, or because there is a near miss which might contribute to an event, or because of new safety information, but also because lessons have been identified that may assist in preventing the reoccurrence of events or that may contribute to safety improvements at other nuclear power plants. It is important to note that the examples used in this manual are for illustration purposes to provide additional guidance for the preparation of IRS reports.

A comprehensive list of the individual codes may also be found in the Web Based IRS application.

2.1. CODING FIELD 1: REPORTING CATEGORIES

The events/information need to be reported under one of the following categories. Complex events may fall and be coded into more than one category.

TABLE 1. CODING FIELD 1: REPORTING CATEGORIES

Code	Field	Examples	Notes
1.1	**Unanticipated releases of radioactive material or exposure to radiation** This reporting category is intended for events/issues involving unanticipated releases of radioactive material to the environment or radiation exposures to plant personnel or members of the public. This category includes actual or potential weaknesses in the implementation of safety measures even if the prescribed limits have not been exceeded. Unanticipated exposures to plant personnel and members of the public that exceed defined limits are also addressed in this category. **This code is not intended to be applied to a report. Use one of its subcodes.**		
1.1.1	Unanticipated releases of radioactive material – without exposures beyond limits	Any release of radioactive material that exceeds prescribed limits whether they are confined to the site or extend beyond it, such as: • An unplanned release that exceeds prescribed limits due to operational errors; • A release of radioactive material that exceeds prescribed limits for off-site or on-site releases due to failure of a storage tank for gaseous or liquid waste; • A release of radioactive material or spread of contamination rendering an on-site area inaccessible, with the result that items important to safety cannot be controlled, tested or maintained, and in which the affected area has to be declared inoperable; • A release of radioactive material or spread of contamination posing a problem for the safety of plant personnel;	None

Code	Field	Examples	Notes
		• A release of radioactive material to the environment through unidentified routes which could not be monitored by the plant equipment (e.g. failure of underground pipework or due to procedural inadequacies in the management of radioactive waste).	
1.1.2	Exposure to radiation that exceeds prescribed dose limits for members of the public	Exposures to members of the public from sources of direct radiation at the site, from an unplanned release due to failure of barriers, or from an unexpected concentration of radioactive material from controlled releases due to inadequacies in waste management systems and/or operations.	Codes 1.1.2 and 1.1.3 are also for cases where the event led to an unanticipated release of radioactive material in the plant, in the environment, or resulted in an unanticipated exposure to plant personnel or the public, even if the release or the radiation dose did not exceed the prescribed limits.
1.1.3	Unanticipated exposure to radiation for site personnel	Exposure to site personnel due to failures in access control procedures, degradation of protection equipment, inadequacies in administrative controls, or due to unplanned on-site releases.	
1.2	**Degradation of barriers and safety related systems** This category is intended to include events/information where actual or potential serious degradation has occurred in the systems designed to maintain the availability of the three fundamental safety functions; i.e. reactivity control, radioactive material cooling and confinement of the radioactive material. **This code is not intended to be applied to a report. Use one of its subcodes.**		
1.2.0	Other degradation	This code is only used when the appropriate code(s) among 1.2.1–1.2.6 cannot be identified. When the failure was found during a periodic inspection, even without an actual effect, the appropriate code in the range 1.2.1–1.2.6 is to be selected.	N/A
1.2.1	Fuel cladding failure	• Fuel cladding failure requiring plant shutdown; • Spent fuel cladding failure during handling operation or and storage in the pool; • Fuel assembly failure (detachment of a fuel rod, spacer grid, etc. from the assembly);	Fuel cladding is the first barrier to prevent a release of radioactive material. Reporting of limited anticipated leaks which do not prevent continued operation is not necessary. Fuel cladding failure or any challenge caused by unexpected

Code	Field	Examples	Notes
		• Fuel failure noticed during off-line and on-line refuelling operations.	factors/failure mechanisms with or without significant release of fission products is also included.
1.2.2	Degradation of the primary coolant pressure boundary, main steam, feedwater line, or other high energy systems **This code is not intended to be applied to a report. Use one of its subcodes.**		
1.2.2.1	*Degradation of primary coolant pressure boundary*	• *Through-wall failure of piping or significant components of the primary coolant circuit;* • *Welding or material related defects in the primary coolant circuits;* • *Loss of relief and/or safety valve functions during tests or operation;* • *Reactor system coolant leakage exceeding technical specification limits or defeating 'leak before break' criteria;* • *Rapid pressure and temperature transient exceeding authorized limits which might jeopardize the integrity of the reactor pressure vessel.*	*The reactor vessel and the reactor coolant system, including all connected equipment (pumps, valves, steam generators, branch pipes up to isolation valves) exposed to reactor pressure, form a second barrier to the escape of fission products.*
1.2.2.2	*Degradation of main steam or feedwater lines*	• *Through-wall failure of piping or significant components of the steam or feedwater lines affecting decay heat removal capacity, the containment function, or resulting in a release of radioactivity;* • *Welding or material related defects in steam or feedwater lines;* • *Loss of relief and/or safety valve functions during tests or operation;* • *Steam generator failure.*	*None*
1.2.2.3	*Degradation of other high energy systems*	• *Through-wall failure of piping or significant components of the steam generator blowdown, letdown lines prior to heat exchange and pressure reduction devices, auxiliary steam system, etc;*	*None*

Code	Field	Examples	Notes
		• *Welding or material related defects in high energy system piping;* • *Loss of relief and/or safety valve functions during tests or operation affecting any adjacent items important to safety;* • *Failure of a high-pressure fluid system of the turbine-generator affecting fire safety.*	
1.2.3	Degradation of containment function or integrity	• Containment leakage rates exceeding technical specification limits; • Loss of containment isolation valve functions during tests or operation; • Loss of containment cooling/spray capability; • Loss of pressure suppression/wetwell function or capability; • Loss of containment function during refuelling operations.	This code may also be selected for the following cases: 1. The containment relief valve opens due to high pressure in the containment vessel; 2. Containment liner degradation is observed; 3. Failure of primary or secondary containment function.
1.2.4	Degradation of systems required to control reactivity	• Failures of the control rod system (full or partial); • Accidental criticality and control rod ejection; • Failures or dilution of the boron injection system; • Failure/inadequacies/dilution of burnable poison; • Failures of recirculation system and/or addition of cold water affecting the reactivity (check also applicability to 1.2.5); • Observed reactivity anomaly or discrepancy in shutdown margin; • Failure of primary/secondary shutdown and liquid poison system; • Failure of demineralizer/ion exchanger affecting the reactivity; • Failure of regulating system including liquid zone control, local power control and moderator level control; • Failures of flux tilt control and local power distribution;	None

Code	Field	Examples	Notes
		• Uncontrolled reactivity oscillation; • Failure in administrative and operational controls (errors in core loading, defects in fuel manufacturing, mistakes in estimation of isotopic concentration of uranium in the fuel, etc.); • Discrepancies observed in calculated and measured values of critical boron concentration.	
1.2.5	Degradation of systems required to ensure primary coolant inventory and core cooling	• Failures of emergency core cooling systems such as the high/low pressure core injection system and the core spray system; • Failure of the primary coolant pump and system; • Loss of auxiliary/emergency feedwater system; • Loss of residual decay heat system, shutdown cooling system, etc; • Failure of the pressure control system and the relief valves; • Failure of the recirculation flow system (check also applicability to 1.2.4); • Loss of moderator cooling and failure of moderator system; • Flow blockage of coolant (full or partial) affecting the fuel integrity.	1. Failure to remove core power or residual heat may result in uncontrolled primary coolant and fuel temperature increases putting fuel integrity at risk. Failures of such related systems are to be covered under this code; 2. Uncontrolled primary coolant system pressure increases may also challenge or jeopardize the integrity of pressure barriers. Failures of such devices are to be covered under this code.
1.2.6	Degradation of essential support systems	• Loss of essential AC/DC power to safety-related buses including control power supply; • Failures of the emergency diesel generator system. • Loss of essential service water, instrument air, fuel oil, gas, ventilation and air conditioning, etc; • Loss of backup fire protection systems used for decay heat removal; • Loss of fire protection system affecting essential equipment/safety systems; • Loss of non-safety system affecting the essential support systems.	None

Code	Field	Examples	Notes
1.3	**Deficiencies in design, construction (including manufacturing), installation and commissioning, operation (including maintenance and surveillance), safety management/quality assurance system, safety evaluation and decommissioning.**		
	Deficiencies related to the above key elements of plant safety involve weaknesses in maintaining the necessary level of safety, which might lead to a loss of safety functions unless rectified. Some of these deficiencies may result in permanent shutdown of the NPP. **This code is not intended to be applied to a report. Use one of its subcodes.**		
1.3.1	Deficiencies in design	• Deficiencies in the design could result in loss of a safety function or unavailability of redundancies in a safety system due to a common cause; • Degradation observed due to material incompatibility, adverse environmental or operating conditions, layout deficiencies, sizing, and computational errors not properly considered during design; • Deficiencies in design of the human–machine interfaces; • Deficiencies in the equipment qualification process.	None
1.3.2	Deficiencies in construction (including manufacturing), installation, and commissioning	• Degradation of materials due to environmental conditions not sufficiently considered or anticipated in the design stage; • Errors made during construction or installation that could influence the performance of the system or component if not detected during testing, maintenance or otherwise; • Deficiencies observed during construction, manufacturing, initial installation and back-fitting of equipment; • Deficiencies due to improper implementation of design modifications during installation and commissioning; • Deficiencies detected during commissioning;	None

Code	Field	Examples	Notes
		• Deficiencies in procurement control of equipment important to safety and services; • Latent deficiencies that have led to events during operation; • Degradation observed in civil structures due to inadequate construction quality/ supervision or unexpected delays without proper management of desirable material conditions; • Quality assurance/ quality control weaknesses observed in manufacturing, installation and commissioning.	
1.3.3	Deficiencies in operation (including maintenance and surveillance)	• Loss of plant capability to perform safety functions due to personnel errors, procedural deficiencies/non-adherence and shortcomings in ergonomics; • Non-adherence to licence conditions, operational limits and conditions, or other provisions; • Inadequacies noticed in diagnostic systems; • Inadequate procedures, guidelines or training.	Personnel errors (including that of contract personnel) occurring during maintenance work are also to be coded here.
1.3.4	Deficiencies in safety management/quality assurance system	• Deficiencies in quality assurance programme/measures; • Deficiencies in work control processes, e.g. wrong documents or tools/devices used for maintenance, or insufficient verification of completed work; • Component does not meet the design requirements; • Quality assurance deficiencies in items not important to safety that might affect items important to safety.	None
1.3.5	Deficiencies in the safety evaluation	• Any event caused by a failure, condition or action that demonstrates a dependence of essential structures, systems and components not previously identified for accomplishing the safety functions;	None

Code	Field	Examples	Notes
		• Any event that results in the nuclear power plant not being in a controlled condition or that results in an unanalysed condition that compromises plant safety; • Deficiencies in the scope of the safety evaluation, event sequences and operating conditions considered in the design analysis; • Environmental conditions not properly considered, unforeseen system interactions, non-conservative calculations and deficiencies in the safety evaluation.	
1.3.6	Deficiencies in decommissioning	• Deficiencies in the decommissioning plan; • Deficiencies in the decommissioning process and implementation of activities; • Generation of radioactive waste being unable to meet acceptance criteria for storage and disposal; • Unacceptable quantities of pollutants and/or hazardous waste; • Spread of contamination due to breach of safety barriers; • Unacceptable radiation exposure to occupational workers, the public and/or the environment.	None
1.4	**Generic problems of safety interest**		
	Deficiencies affecting several plant systems or components, or having implications for other plants, or indicating the existence of generic problems of safety significance are to be reported. Examples: • A series of events where the individual events by themselves are not of significant importance; • Reoccurring events; • Events with implications for similar facilities; • Generic problems not adequately addressed by operation experience feedback, research or regulatory requirements.		

<table>
<tr><th>Code</th><th>Field</th><th>Examples</th><th>Notes</th></tr>
<tr><td rowspan="2">1.5</td><td colspan="3">Enforcement and consequential actions taken by the regulatory body</td></tr>
<tr><td colspan="3">Changes made by the regulatory body to the licensing conditions of nuclear power plants based on lessons learned from reported events, imposition of additional licence conditions or other enforcement actions.

Examples:

• Warning notices, prohibitions, prosecutions, etc., resulting from information received by the competent safety authority through reported events or other means and relating to:
  • Licensing and/or licence conditions;
  • Design/safety assessment/safety analysis;
  • Construction;
  • Commissioning;
  • Operation;
  • Emergency planning;
  • Training and qualifications;
  • Decommissioning.</td></tr>
<tr><td rowspan="2">1.6</td><td colspan="3">Events of potential safety significance</td></tr>
<tr><td colspan="3">Events/near-misses having no actual significant safety consequences but having the potential to become safety significant.

Examples:

• Events that could lead to potential loss of a safety function;
• Failure of mid-loop operation, header level control or loss of natural circulation;
• Loss of water in a spent fuel storage facility that might lead to uncovering of spent fuel elements;
• Loss of shielding capability;
• Fall of spent fuel assembly during refuelling without any consequences;
• An accident during the transport of a package containing radioactive material without any consequences.</td></tr>
</table>

Code	Field	Examples	Notes
1.7	**Effects of unusual events of either human or natural origin**		
	Events (internal and external) that could challenge the ability of the plant to operate, to shut down or to safely maintain shutdown conditions. Examples: • Natural events, including earthquakes (within or exceeding the design limit) tsunamis, floods, heavy rain or snowfall, ice formation, pollution of river water or seawater, high winds, cyclones and tornadoes, lightning; • External human induced events including explosions, fires, public demonstrations, industrial transportation accidents and aircraft crashes; • Internal events including explosions, fires, flooding, labour disputes, toxic gas releases and turbine missiles; • External and internal acts of sabotage or terrorism; • Electromagnetic/radio frequency interference.		
1.8	**Other findings and operating experience information**		
	New perspectives, industry initiatives, operating experience feedback from other industries are to be reported. Examples: • Failures in other industries applicable to the nuclear industry; • New safety requirements due to severe accident management guidelines; • Risk-based and risk-informed insights.		

2.2. CODING FIELD 2: PLANT STATUS PRIOR TO THE EVENT

The plant status at the time of the event needs to be indicated in the IRS report even if it has no relation to the sequence of the event. In this case the code ‘2.0 Not Applicable’ is also used along with the appropriate plant status code.

TABLE 2. CODING FIELD 2: PLANT STATUS PRIOR TO THE EVENT

Code	Field	Notes
2.0	**Not Applicable**	None
2.1	**On Power**	
	This code is not intended to be applied to a report. Use one of its subcodes.	
2.1.1	Full allowable power	This code covers stable operation above 90 percent power.
2.1.2	Reduced power (including zero power)	This code covers stable operation from criticality to 90 percent power.
2.1.3	Raising power or starting up	This code covers starting of the unit from cold or hot shutdown to power rise. This code also covers reactor startups for shutdown margin tests, low power physics tests, cold criticality tests, or any other similar tests.
2.1.4	Reducing power	This code covers the period of power reduction of the unit
2.1.5	Refuelling on power	Some reactors, for example CANDU and gas cooled reactors (GCR), can be refuelled during power operation. For these types of reactors, this code can be selected.

Code	Field	Notes
2.2	**Hot shutdown conditions**	
	This code is not intended to be applied to a report. Use one of its subcodes.	
2.2.1	Hot standby (coolant at normal operating temperature)	In this state, primary coolant is around normal operating temperature with the reactor subcritical.
2.2.2	Hot shutdown (coolant at or below normal operating temperature)	In this state, primary coolant temperature is less than the normal operating temperature (but greater than the cold shutdown temperature limit depending on reactor design) and with the reactor subcritical and the vessel closed.
2.2.3	Natural circulation cooling	This code covers the effect of natural circulation cooling during hot shutdown conditions.
2.3	**Cold Shutdown (reactor sub-critical and coolant temperature < 93°C)**	
	This code is not intended to be applied to a report. Use one of its subcodes.	
2.3.1	Cold shutdown with closed reactor vessel	In this state, the primary coolant temperature is lower than the hot shutdown temperature limit, depending on reactor design, with reactor vessel closed.
2.3.2	Refuelling or open vessel (for maintenance)	For reactors (PWR, BWR, etc.) where the reactor vessel needs to be opened for refuelling this code is selected in addition to other relevant codes. The reactor vessel is also opened for inspection or maintenance. **This code is not intended to be applied to a report. Use one of its subcodes.**

Code	Field	Notes
2.3.2.1	*Refuelling or open vessel – all or some fuel inside the core*	*This code covers the reactor vessel in a flooded condition for fuel movement and for inspection and maintenance.*
2.3.2.2	*Refuelling or open vessel – all fuel out of the core*	*This code covers the reactor vessel in a flooded or drained condition for inspection and maintenance with the fuel removed fully from the core.*
2.3.3	Mid-loop operation and other reduced primary coolant inventory conditions	This code covers mid-loop operation or header level control with a reduced primary coolant inventory for specialised maintenance activities.
2.3.4	Natural circulation cooling	This code covers the reactor in cold shutdown with decay heat removed by natural circulation.
2.4	**Pre-operational**	
	This code is not intended to be applied to a report. Use one of its subcodes.	
2.4.1	Construction, installation	The plant is under construction with the installation of structures, systems, and components in progress.
2.4.2	Commissioning	This code covers events/information relating to any commissioning activity conducted during the pre-operational phase of a reactor. It may be applied to commissioning activities conducted during the construction phase and up to the beginning of commercial operation. Preoperational and commissioning phases marked with this code can also be assigned other codes from Coding Field 2.

Code	Field	Notes
2.5	**Testing or maintenance being performed**	
	This code covers only the case where test or maintenance work is directly related to the event, including the case where the failure was discovered during testing or maintenance. It will always be used together with other codes in this section.	
2.6	**Post-operational (decommissioning/dismantling/decontamination)**	
	This code covers events/information relating to the post-operational phase of a reactor.	
2.7	**Refurbishments (major upgrades/major modifications)**	
	This code covers events/information relating to reactor refurbishment projects	

2.3. CODING FIELD 3: FAILED/AFFECTED SYSTEMS

This field identifies:

- Systems that failed or lost normal function, thereby initiating or triggering the event;
- Systems that lost normal function or were damaged as a direct result of the event;
- Systems important to safety that were damaged or affected either during the event, or as a result of the event.

Systems distinguished with subdivisions under this code are:

A. Primary systems;
B. Essential reactor auxiliary systems;
C. Essential service systems;
D. Essential auxiliary systems;
E. Electrical systems;
F. Feed water, steam and power conversion systems;
H. Heating, ventilation and air conditioning systems (HVAC);
I. Instrumentation and control systems;
K. Service auxiliary systems;
S. Structural systems;
W. Waste management systems;
Z. No system involved;

Some components or sub-components in a system can be categorized in more than one code, particularly if it has two or more functions (e.g. activating or de-energizing other systems). In such cases, all codes that represent the dependency of those systems on the component or sub-component that has lost its normal function or is affected need to be selected.

Only systems that play a direct role in the cause of the event are coded, either because the system failed or lost its normal function, thereby triggering the event or because the system lost its function, was damaged or affected, either during the event or as a result of the event.

Although many systems may be affected by the event or are actuated as a result of the event, they are not selected for coding if the system functions as designed or if the functional loss is not safety-related (see the examples with explanations provided in this section).

In the following tables a detailed description of systems is given along with the constituting parts or components.

TABLE 3. CODING FIELD 3.A: PRIMARY SYSTEMS

Code	Field	Description	Notes
3.A	**Primary systems**		
	Primary systems are systems and components that specifically confine and control the nuclear reaction and provide safety functions that cool and shut the reactor down during normal operations and in the case of a failure or malfunction. Primary systems include the components and sub-components of fuel, moderators, steam generators, heat exchangers, coolant systems, control rods, pressure vessel/tubes, etc. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.AA	Reactor core (fuel assemblies, control and poison rods, guide thimbles)	Reactor core system may consist of fuel assemblies, spacer grids, control rods or control assemblies, burnable poison rods, neutron startup sources, and thimble guide tubes. The moderator system of the GCR, AGR and RBMK type reactors is included in (3.AA). The fuel assemblies consist of the fuel rods, spacer grids and plates, guide thimbles and plugs, burnable poison rods and all other parts needed for a complete fuel bundle. The control assemblies consist of the control rods, shut-off rods, adjusters, zone controllers, etc. and the assembly structure up to and including the coupling socket (this code basically covers reactor trip and control elements).	1. Even if a fuel assembly or control rod was damaged in the storage pool or during movement inside the plant, (3.AA) is to be selected. 2. The control rod drive system is included in (3.AB). 3. Baffle plates, core support plates, the core barrel and other reactor internals are included in (3.AC). 4. In PHWRs, the adjusters comprise absorber rods, regulating rods and shim rods.
3.AB	Systems for reactor control and protection (e.g. control rod drive mechanism, accumulator, motor, power supply, hydraulic system, other shutdown systems)	Systems for reactor control (3.AB) provide means of controlling the reactor power level by changing the position of the control rod assemblies in the reactor core system (3.AA). These systems also provide the principal means of quickly and safely shutting down the reactor in response to a trip signal.	1. Control rod drive cooling water is included in (3.CA). 2. The normal control rod drive control signal is included in (3.IK).

Code	Field	Description	Notes
		The electronic system that is a part of the motor assembly is included in (3.AB). In PWRs, the control rod drive system (3.AB) consists of control rod drive mechanisms and associated electrical power supplies. This system includes motor assembly, coil stack assembly, reed switch assemblies, extension shaft assembly, etc. In BWRs, the control rod drive system (3.AB) consists of the control rod drive mechanisms, the hydraulic control unit for each control rod drive mechanism, the common hydraulic power supply, scram discharge volume tank, etc. In PHWRs, the primary/secondary shutdown system (3.AB) consists of moderator dumping/shutoff rods/liquid poison injection/etc. and supported auxiliaries such as clutches, tanks, valves, etc.	3. The scram signal is included in (3.IN). 4. Guide plates, assemblies and the pressure housings for the upper and lower control rod drive mechanisms are part of the reactor vessel system (3.AC). 5. The control rod position indicators in the main control room are included in (3.IE), however, the detector reed switch is included in (3.AB). 6. The reactor trip breaker is included in (3.IN). 7. The nitrogen for the accumulators of (3.AB) is included in (3.KC).
3.AC	Reactor vessel (with core internals, PHWR or LWGR pressure tubes, etc.)	The reactor vessel (3.AC) houses the reactor core. For PWRs, it consists of the reactor pressure vessel, head, core support plates, core barrel, baffles, pressure tubes for control rod assemblies and thimbles, stand pipes, support castings, all nozzles (on vessel) and other internals except those included in the reactor core system (3.AA). For BWRs, it includes the reactor pressure vessel and level instrumentation taps, support plates, core shroud, core plate, internal standby liquid control piping, core spray sparger, feedwater sparger, jet pumps and risers and all other internals not included in the reactor core system (3.AA).	None

Code	Field	Description	Notes
		For PHWRs and HWLWRs, the pressure tubes and associated components are (3.AC), and the calandria tank and tubes are (3.AD). For GCRs (3.AC) includes the penetrations.	
3.AD	Moderator and auxiliaries including neutron poison removal system (PHWR)	This code is used for the reactors that have a liquid moderator system, for example PHWR and HWLWR. The moderator and auxiliaries system (3.AD) consists of the moderator tank (calandria) and tubes, moderator cover gas system, moderator make-up system, neutron poison removal/ion exchange system, and other moderator-related systems.	1. The moderator dump system for emergency scram is included in (3.AB). However, the rest of the moderator system and its auxiliaries are included in (3.AD). 2. The moderator system of GCRs, AGRs and RBMKs is included in (3.AA).
3.AE	Primary coolant system (pumps and associated materials, loop piping etc.)	This code is used for reactor types that have a secondary circuit, i.e. PWR, AGR, GCR, and PHWR. The primary coolant system circulates the cooling fluid through the reactor vessel, removes heat from the reactor core and internals, transferring it to the secondary system via the steam generators or heat exchangers. For GCRs and AGRs, the coolant circulation pump, fan and guide vane are included in (3.AE). The primary coolant drains and vents up to the second isolation valves are also included in (3.AE). The major components of this system are the reactor coolant pumps, lube oil pumps and coolers, associated loop piping, insulation, and pipe supports.	1. The pressurizer and related relief valve are included in (3.AF). 2. The primary pump seal water supply system is included in (3.BF). 3. Drainage components including piping, valves, drain tank, pipe supports and hangers are included in (3.WG).
3.AF	Pressure control (includes primary safety and relief valves)	The pressure control system (3.AF) provides a means of controlling the pressure in the primary coolant system. The pressurizer spray actuation signal is included in (3.AF). The pressure control system (3.AF) consists of the pressurizer, pressurizer heaters and sprays, safety and relief valves, block	1. The indicator of relief valve position is included in (3.IE). 2. The pressure relief/safety valve of the primary circuit

Code	Field	Description	Notes
		valves, feed and bleed control valves, surge tank, pipes, insulation and pipe supports and hangers.	of a BWR is included in (3.BK).
3.AG	Recirculating water system (BWR)	The recirculating water system (3.AG) provides forced cooling through the reactor vessel to remove the heat generated by the nuclear reaction. BWR power control is included in (3.AG). The system consists of internal/external recirculation pumps, some designs also have a flow control valve, motor operated gate valves for pump isolation, pipes, insulation and pipe supports. This system also includes lube oil pumps and coolers.	1. The jet pump assembly is included in (3.AC). 2. The parts of the ATWS (Anticipated Transient Without Scram) function that trip the recirculation pumps as a secondary unit shutdown system, are included in (3.IN).
3.AH	Steam generator, boiler steam drum	This code is used for reactor types that have one or more secondary loop(s) or circuit(s); e.g. PWR, AGR, GCR, and PHWR. The primary function of (3.AH) is to transfer heat from the primary coolant system to the secondary coolant system while maintaining separation between these systems. Steam generator system (AH) consists of the steam generators, their internals and nozzles, and related supports. For AGR and GCR, (AH) is the boiler system.	None
3.AK	At power fuel handling systems (PHWR, LWGR, GCR)	At power fuel handling systems (3.AK) include the refuelling machines, spent fuel transfer system, and components that ensure the integrity of the fuel and pressure boundary. These systems include the indicators that provide assurance of the leaktightness of the pressure boundary before and after refuelling operations, and of the integrity of the fuel.	(3.AK) does not include fuel assemblies, etc. which are part of the reactor core (3.AA).
3.AL	Annulus gas	The primary function of the annulus gas system (3.AL) is to monitor ‘leak before break’ of pressure tubes of PHWR units. This system includes tubing, diagnostic systems, and associated equipment.	None

TABLE 4. CODING FIELD 3.B: ESSENTIAL REACTOR AUXILIARY SYSTEMS

Code	Field	Description	Notes
3.B	**Essential reactor auxiliary systems**		
	Essential reactor auxiliary systems provide support to the safety functions necessary to mitigate the consequences of an accident which could lead to core damage and to the release of radioactivity to the environment. The consequences of failure of these auxiliary systems needs only to be considered after an initial failure of a safety function. Please note that codes 3.BM and 3.BN are unused **This code is not intended to be applied to a report. Use one of its subcodes**.		
3.BA	Reactor core isolation cooling (BWR)	Reactor core isolation cooling system (3.BA) includes the two Essential reactor auxiliary systems provide support to the safety functions necessary to mitigate the consequences of an accident which could lead to core damage and to the release of radioactivity to the environment. The consequences of failure of these auxiliary systems needs only to be considered after an initial failure of a safety function. following systems: a) Reactor core cooling system This system provides cooling water to the reactor vessel during a loss of normal feedwater flow. Components of this system may include the steam-driven turbine, pump, condenser, condensate pump, vacuum pump, valves and actuators, pipes, pipe supports and hangers. b) Isolation/emergency condenser system The isolation condenser system provides cooling by natural circulation for the reactor if feedwater capability is lost and heat removal systems that need electric power for operation are not available. This system may consist of the condensers, the	In some BWRs, the residual heat removal systems have the reactor isolation cooling function. In such a case, this function is included in both (3.BA) and (3.BE).

Code	Field	Description	Notes
		condenser make-up tank, valves and actuators, pipes, pipe supports and hangers, and miscellaneous drains.	
3.BB	Auxiliary and emergency feedwater	The auxiliary and emergency feedwater system (3.BB) provides emergency cooling capability for the steam generators (3.AH) so that the primary coolant system (3.AE) can be cooled. In some units, this system supplies feedwater during startup, shutdown, and low power operation. Components for this system include turbine driven pumps, electric motor driven pumps, valves and actuators, pipes, pipe supports and hangers.	None
3.BC	Emergency poisoning function (PWR mainly with the boron injection tank, chemical and volume control system participation)	Soluble poisons (boron) are used in emergency shutdown systems in PWRs. PHWRs use gadolinium in one of the reactor emergency shutdown systems but also use soluble poison (boron or gadolinium) to support reactivity control. The emergency shutdown system is always poised during reactor operation but can also be actuated manually by operating personnel. The poison solution for routine reactivity control can be injected into the moderator to decrease the reactivity either automatically or manually. The main components of (3.BC) are the poison tanks, and associated equipment, piping, and valves. In PWRs the boron injection tank is the source of water initially injected by the high-pressure safety injection pumps (3.BF) and (3.BG). This system consists of the tank, pipes, pipe supports and insulation.	1. Isolation valves, recirculation piping to and from the chemical and volume control system are included in (3.BF). 2. The safety injection system is included in (3.BG).
3.BD	Standby liquid control (BWR)	The standby liquid control system (3.BD) provides a means of shutting the reactor down by injecting boron solution into the reactor vessel (3.AC). This system is used only in the unlikely event that the control rods cannot be inserted into the reactor core (ATWS).	None

Code	Field	Description	Notes
		The system primarily consists of a boron solution storage tank, positive displacement pumps, test tanks, accumulators, valves and actuators, pipes, pipe supports and hangers.	
3.BE	Residual heat removal (PWR and BWR except emergency core cooling functions).	The residual heat removal system consists of pumps, heat exchangers, valves, pipes, insulation, pipe supports and hangers and any drain lines. The system has both normal and emergency modes of operation. During emergency mode, the residual heat removal system can be used for low pressure safety injection.	1. The emergency core cooling function is included in (3.BG). 2. The borated/refuelling water storage tank is included in (3.CD). 3. The cooling water for the heat exchanger is included in (3.CA). 4. The BWR containment spray and torus/wet well spray system is included in (3.DD). 5. Code (3.BE) is selected up to the last isolation valve between systems (3.BE) and (3.DD).
3.BF	Chemical and volume control (PWR with main pumps shaft seal water)	The chemical and volume control system (CVCS) (3.BF) serves many functions, including: • Maintaining the primary coolant system (3.AE) boron concentration. • Maintaining the proper water inventory for the primary coolant system. • Providing seal water to the primary coolant pump shaft seals. • Maintaining the proper concentration of corrosion inhibiting chemicals in the primary coolant. • Purifying the coolant. • Degassing the primary coolant system.	1. The seal water supply system to primary pump is included in (3.BF). 2. Nitrogen supplies for various tanks of (3.BF) are included in (3.KC). 3. The boron recovery system is included in (3.WA). 4. The high pressure safety injection function of the chemical and volume control system is included in both (3.BF) and (3.BG).

Code	Field	Description	Notes
		• In some designs, it provides borated water for emergency core cooling at reactor pressure (high pressure safety injection function). Components for the chemical and volume control system may include charging pumps, letdown chillers, letdown reheater, seal water and regenerative heat exchangers, ion exchangers, demineralizers, volume control tank, boric acid storage tanks, boric acid transfer pumps, mixing and holdup tanks, blenders, chillers, filters and strainers, valves and actuators, pressure reducing orifices, pipes, insulation and pipe supports and hangers.	5. The purification system of GCR and AGR are included in (3.BF).
3.BG	Emergency core cooling	The emergency core cooling system may include the following systems: (a) High or intermediate pressure coolant injection system (PWR, PHWR). • The high or intermediate pressure injection system provides borated water to the primary coolant system (3.AE) for flooding and cooling of the reactor core (3.AA) following a loss of coolant accident (LOCA). This system also assures decay heat removal and injection of borated water to increase the shutdown margin following a rapid cooldown of the reactor due to a steam-line rupture. • In PHWRs, if the reactor pressure drops below the set pressure during a LOCA, depending on the reactor design, heavy water or light water is forced into the primary coolant system of the reactor vessel. • The components are accumulator, tanks, pumps, lube oil pumps and coolers, valves and actuators, pipes, insulation and pipe supports and hangers. (b) Low pressure core cooling system (PWR, PHWR).	1. Coolant injection by accumulators (for PWRs) is included in (3.BL); for PHWRs it is included in (3.BG). 2. Low pressure core cooling, if provided by the residual heat removal system, is included in (3.BG). 3. The emergency core cooling function of the chemical and volume control system (3.BF) is included in (3.BF) and/or (3.BG) depending on the affected function. 4. The emergency core cooling function of the residual heat removal system (3.BE), i.e. low pressure and safety/coolant

Code	Field	Description	Notes
		• The primary purpose of the low-pressure core cooling system is to supply emergency coolant during large breaks in order to flood the uncovered core of the depressurized reactor and to provide long term decay heat removal, both in the injection mode from the borated water storage tank (3.CD), and in the recirculation mode from the sump on the floor of the primary reactor containment building (3.SA). • The major components of the system are pumps, fuel oil pumps and coolers, valves and actuators, associated pipes, insulation, and pipe supports and hangers. (c) High pressure coolant injection system (mainly BWR). • The high-pressure coolant injection system provides high pressure emergency core cooling capability. The flow rate of the system will ensure the reactor core is adequately cooled until the reactor pressure drops sufficiently to permit the low pressure core cooling system to inject into the reactor. • System components may include the injection pump, booster pump, steam driven turbine, valves, turbine and pump lubrication system, drains, gland seal condenser and pump, associated pipes, pipe supports and hangers. (d) High pressure core spray system (mainly BWR). • The primary purpose of the high pressure core spray system is to maintain the reactor vessel inventory after small breaks which do not depressurize the reactor. The system also provides spray cooling heat transfer during breaks in which the core might be uncovered. The primary source of water for this system is the condensate storage tank (3.CE). The suppression pool (3.SA) serves as the secondary water source. • The high pressure core spray system may include spray pumps, line-fill pumps, valves, lubrication components, drains and vents, pipes, and pipe supports and hangers.	injection function is included in (3.BE) and/or (3.BG) depending on the affected function. 5. The ‘keep fill’ system, which keeps pipes full of water to prevent water hammer, is also to be included in (3.BG). 6. The air supply system to control the valves in (3.BG) is included in (3.CC).

Code	Field	Description	Notes
		• The core spray sparger ring and spray nozzles are part of the reactor vessel system (3.AC). (e) Low pressure core spray system (mainly BWR). • The primary purpose of the low-pressure core spray system is to provide inventory make-up and spray cooling during large breaks in which the core is uncovered. It also provides inventory make-up for small breaks. Primary and secondary sources of water are the suppression pool (3.SA) and the condensate storage tank (3.CE). • The low pressure core spray system may include spray pumps, line-fill pumps, valves, drains and vents, lubrication components, pipes and pipe supports and hangers. • The core spray sparger ring and spray nozzles are part of the reactor vessel system (3.AC).	
3.BH	Main steam pressure relief (reactors which have one or more secondary loop(s) or circuit(s)).	The main steam pressure relief system (3.BH) provides pressure relief for the main steam system (3.FA) in the event of load change or turbine trip. The method of pressure relief is steam discharge to the atmosphere through relief and safety valves. The relief and safety valves are usually used only when the steam dump to the main condenser via the turbine bypass system (3.FE) is unavailable or has insufficient capacity. The system mainly consists of the relief and safety valves, control valves, piping from the main steam line to the valves, vent pipes, pipe supports and hangers, and drains.	None
3.BK	Nuclear boiler overpressure protection (BWR)	The nuclear boiler overpressure protection system (3.BK) prevents over pressurization of the nuclear system by venting steam to the suppression pool for condensation. The safety/relief	None

Code	Field	Description	Notes
		valves vent steam if the turbine bypass system (3.FE) is unavailable. This system consists mainly of safety/relief valves, control valves, piping from the main steam line (3.FA) to the suppression pool (3.SA), automatic depressurization system (ADS) accumulators, pipes, insulation, pipe support and hangers.	
3.BL	Core flooding accumulator (PWR)	The core flooding accumulator system (3.BL) may include two types of systems: (a) Core flooding accumulator system This system has accumulators filled with borated water and pressurized with nitrogen gas. If the reactor pressure drops below the accumulator's pressure, the borated water is forced into the primary coolant system or the reactor vessel. This system consists of the accumulators, valves, piping from the accumulators to the emergency cooling system injection header or to the reactor vessel, it also includes pipes, and pipe supports and hangers. (b) Upper head injection system This system has two large accumulators. One of the accumulators is filled with borated water, the other with pressurized nitrogen, which provides a cover gas that propels the contents of the water-filled accumulator into the reactor vessel. This system consists mainly of the two large accumulators, a surge tank, valves, pipes, pipe supports and hangers.	Nitrogen cover gas for the accumulators of (3.BL) is included in (3.KC).
3.BP	Failed fuel detection system	Failed fuel refers to a breach in the fuel cladding of an irradiated fuel assembly in a nuclear reactor. Neutron detection, gamma detection or fission product monitoring (such as iodine) are	None

Code	Field	Description	Notes
		commonly used in failed fuel detection. The identification of the location of the failed fuel is normally done out of the core. This code is used for failure of the off-line detection system employed or failure of any subsidiary component of the detection system.	
3.BQ	Gas clean-up system (LWGR, PHWR)	A cover gas (helium) clean-up system is used in some designs to maintain moderator system operability.	None
3.BR	End shields and associated cooling system (PHWR)	The end shields are surrounded by a shield cooling tank designed to allow access to the fuelling machine area and reactor face and to fulfil structural and support functions. The space between the calandria shell and the shield cooling tank shell is filled with light water, which serves as a thermal and biological shield. The light water in the shield tank and end shield cavities is circulated and cooled. The end shield and the shield cooling systems are designed to remove heat from the shielding material as well as heat transferred from the reactor coolant system. This code is used for main components and sub-components of the end shields and the associated cooling system.	None

TABLE 5. CODING FIELD 3.C: ESSENTIAL SERVICE SYSTEMS

Code	Field	Description	Notes
3.C	**Essential service systems** Essential service systems are those systems mainly used to provide cooling or back up to items important to safety that are required to function during and following an accident. Redundant flow paths are normally available to ensure that no single failure would cause a system failure. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.CA	Component cooling water (including reactor building closed cooling water)	The component cooling water system (3.CA) acts as an intermediate heat sink for heat removal from potentially radioactive heat loads during normal operation, anticipated operational occurrences and accident conditions. Thus, the component cooling water system acts as a barrier between radioactive systems and the environment. The heat is transferred to the cooling service system (3.CB) for release to the environment. This major components of this system are cooling pumps, lube oil pumps and coolers, heat exchangers, surge tanks, valves, pipes and pipe supports and hangers.	The control rod (adjuster rod) cooling system is included in (3.CA).
3.CB	Essential raw water cooling or service water	The essential raw water cooling/service water system (3.CB) is an open or closed system, using water from the environment and discharging heat to the environment in an open system or recirculation water, by dissipating heat to the environment (e.g. via cooling towers in a closed system), which acts as the final heat sink for primary system components. This system (3.CB) provides the cooling water to the heat exchangers of (3.CA). The major components in this system are heat exchangers, centrifugal pumps, travelling screens, screen wash pumps,	None

Code	Field	Description	Notes
		backwash strainers, valves and their operators, pipes and pipe supports and hangers.	
3.CC	Essential compressed air (e.g. instrument air, etc.)	The essential compressed air system (3.CC) supplies dry, filtered air to operate safety-related components such as valves and seals. The system mainly consists of air compressors, heat exchangers, air receivers, strainers, filters, driers, accumulators, valves and actuators, pipes, and pipe supports and hangers.	None
3.CD	Borated or refuelling water storage (PWR)	The borated or refuelling water storage system (3.CD) is the borated refuelling water storage tank that supplies reactor-grade, borated water to fill the pool during fuel transfer between the reactor vessel and the spent fuel pool. In some designs it also provides water to the emergency cooling system (3.BG) during accident conditions.	None
3.CE	Condensate storage	The condensate storage system (3.CE) provides a means of controlling the water inventory in the turbine cycle by supplying water to or accepting water from the main condenser (3.FC). The condensate storage system usually supplies water to the seal water system (3.FG) or to the condensate and feedwater system (3.FG), auxiliary feedwater system (3.BB), reactor core isolation cooling system (3.BA), residual heat removal system (3.BE), high pressure coolant injection system (3.BG), high pressure core spray system (3.BG) and low pressure core spray system (3.BG) (depending on the plant design). Components for this system include condensate storage tank, transfer pumps, valves and actuators, pipes, and pipe supports and hangers.	(3.CE) is used only in the case of failure to supply water to safety systems and items important to safety.
3.CF	CO_2 injection and storage (GCR)	The CO_2 injection and storage system for GCRs supplies purified CO_2 gas to the main circulating circuit. It includes the storage tanks, pumps, valves, pipes, and pipe supports and hangers.	None

TABLE 6. CODING FIELD 3.D: ESSENTIAL AUXILIARY SYSTEMS

Code	Field	Description	Notes
3.D	**Essential auxiliary systems**		
	Essential auxiliary systems are those systems that provide necessary services to ensure the continued operation of the nuclear power plant and which also provide radiation protection to personnel, and protection for plant equipment and the environment against harmful effects of ionizing radiation. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.DA	Spent fuel pool or refuelling pool cooling and clean-up	The purpose of the spent fuel pool/refuelling pool cooling and clean-up system (3.DA) is to remove decay heat from the spent fuel elements, to keep the pool clean for good visibility during fuel handling and to minimize contaminants in the fuel pool. The spent fuel inspection bay receiving the spent fuel before transfer to spent the fuel pool/refuelling pool is also included in (3.DA). The major components of the system are pumps, heat exchangers, filters, demineralizers, valves and associated pipes and pipe supports and hangers.	In some designs, this system uses the filters and demineralizers of the suppression pool and clean-up system (3.WH).
3.DB	Containment isolation (including penetrations and air lock door seals)	The containment isolation system (3.DB) may consist of the following two systems: (a) Containment isolation system: The containment isolation system (3.DB) may provide a means for: • Isolating the various fluid, pneumatic, heating, ventilation and air conditioning systems that penetrate the containment; • Isolating instrument line penetrations; • Isolating personnel airlocks/hatches and equipment access airlocks/hatches; • Isolating fuel handling penetrations.	1. The main steam isolation valves are included in (3.DC); 2. The reactor building/suppression chamber vacuum breakers are included in (3.DB).

Code	Field	Description	Notes
		The major components are valves and actuators, pipes, pipe sleeves, seals, doors, penetrations, dampers and ductwork. (b) Containment isolation leak control system: The system serves to prevent a radioactive release to the environment after the occurrence of a LOCA, through the use of closed isolations (other than main steam isolation valves) and containment air lock door seals. Upon operation, the system supplies air or water to the various valves and the containment air lock door seals at a pressure greater than the containment pressure. This system consists of a compressor, separator, heat exchanger, air receiver, valves and actuators, pipes and pipe supports and hangers.	
3.DC	Main steam or feedwater isolation function		
	This code is not intended to be applied to a report. Use one of its subcodes.		
3.DC.1	*Main steam isolation function*	*The main steam isolation valve system (3.DC.1) consists of the two following parts:* *(a) Main steam isolation valves: including the valves, related pilot valves, pipes and pipe sleeves.* *(b) The main steam isolation valves leakage control: to prevent the release of radioactivity to the plant environment from leakage of the main steam isolation valves following a LOCA. It consists of valves and actuators, pipes and pipe support and hangers.*	*None*

Code	Field	Description	Notes
3.DC.2	*Feedwater isolation function*	*In some designs, the main feedwater isolation system (3.DC.2) plays an important role in an emergency shutdown by preventing the reactor from losing its protective cooling water. The system includes valves and actuators, pipes and pipe supports and hangers.*	*None*
3.DD	Containment atmosphere clean-up/treatment systems (spray, iodine removal, etc.)	Containment pressure reduction systems (3.DD) may include the following three systems: (a) Containment spray system • The containment spray system functions to reduce containment pressure and airborne fission products in the containment atmosphere following a LOCA or a steam line break; • The major components may include containment spray pumps, spray additive tank, liquid jet ejector, spray headers and nozzles, isolation valves, pipes and pipe supports and hangers; • In some BWRs the containment spray system is an integral part of the residual heat removal system or ECCS. In case of degradation of this function, (3.DD) and/or (3.BE/3.BG) are/is selected depending on the affected function. (b) Containment ice condenser system • The containment ice condenser system limits the containment atmospheric pressure to an acceptable value by cooling and condensing the steam with ice following a LOCA. The ice condenser is filled with borated ice which, when it melts, maintains the boron concentration in the containment sump; • Components for the containment ice condenser system may include the ice condenser structure, an ice-making machine, borated ice, ice baskets, and doors leading to the ice condenser compartment.	None

Code	Field	Description	Notes
		(c) Compartment spray system • In some VVER reactor types the main components (primary pumps, pipes, steam generators, etc.) are housed in a steam generator compartment. The spray system for this compartment is included in (3.DD).	
3.DE	Containment pressure suppression	The containment pressure suppression system (3.DE) makes up the suppression pool water to maintain the suppression pool dynamic loading. The main components are valves and actuators, pipes, ducts and pipe supports and hangers. This system includes the suppression pool water cooling system.	1. The passive pressure suppression system of some VVER reactor types (e.g. the bubble steam condenser tower) is included in (3.DE). Pressure suppression systems in any other reactor types are also included in (3.DE); 2. In some designs the ventilation system has also the function of pressure reduction (suppression). This is included in (3.HA).
3.DF	Containment combustible gas control	To eliminate the possibility of an in-containment post-accident hydrogen explosion, the containment combustible gas control system (3.DF) controls hydrogen concentration in the containment atmosphere by recombination, air mixing and/or dilution with nitrogen.	1. The hydrogen-oxygen analyser is included in (3.IQ); 2. Nitrogen supply facility for hydrogen dilution (inerting) is included in (3.DF).
3.DG	Essential auxiliary steam (GCR)	Essential auxiliary steam is used to provide steam for reactor startup and to provide steam when main steam is unavailable e.g. post-accident. This code may also be applicable to other reactor types.	None

TABLE 7. CODING FIELD 3.E: ELECTRICAL SYSTEMS

Code	Field	Description	Notes
3.E	**Electrical systems**		
	Electrical systems are those systems that provide flow of electricity to other system's components to ensure the continued operation of the nuclear power plant and which also provide emergency backup supply to ensure the facility can continue to ensure the health and safety of the public. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.EA	High voltage AC (greater than 15 kV)		
	The high voltage AC system (3.EA) includes all electrical systems and components of voltage greater than 15kV, including all on-site (3.EA.1) and off-site power sources (3.EA.2). **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.EA.1	*High voltage AC - On-site*	*This system includes electrical generators of output rating greater than 15 KV, generator transformer/main transformer (GT), bus ducts, transmission lines from GT to switchyard including generator circuit breaker (GCB), generator and transformer control systems, protective relays, buses, startup transformers primary side and switchyard equipment, such as towers/gantries, disconnect switches, power circuit breakers, lightning arrestors, current and potential transformers, etc.*	*1. Loss of partial on-site power including the switchyard is included in (3.EA.1);* *2. Related breakers are also included in (3.EA.1);* *3. The insulating oil in the transformers is included in (3.EA.1);* *4. If the generator output is less than 15 KV then the GT low-voltage side and station service transformer and associated equipment are included in (3.EB).*
3.EA.2	*High voltage AC - Off-site (including grid and transmission lines)*	*This system mainly includes the electrical grid supplying power, transmission lines (power evacuation and receiving) and their control systems, protective relays, buses, disconnect switches,*	*1. Loss of off-site power, including partial loss of electrical grid, is included in (3.EA.2);*

Code	Field	Description	Notes
		power circuit-breakers, lightning arrestors and current and potential transformers.	2. *Related breakers and equipment used in power transmission are included in (3.EA.2).*
3.EB	Medium voltage AC (higher than 600V up to 15kV)	Medium voltage AC system (3.EB) includes all electrical systems and components of voltage greater than 600 V AC but less than or equal to 15 kV AC. This system includes electrical generators of output rating less than or equal to 15 kV and associated GT and GCB, bus ducts, transmission lines from the GT to the switchyard, generator and transformer control systems, protective relays, buses etc. Start-up transformers secondary side and associated equipment are included in (3.EB). The primary side of more than 15 KV is included in (3.EA.1). Secondary-side power sources (startup transformer, station service transformer, house-load transformer, etc.) between 600 V to 15 kV are included in (3.EB). Emergency power supplies of between 600 V and 15 kV (diesel generator or gas turbines, etc.) are also included in (3.EB). The major components are transformers, buses, cables, relays, circuit breakers and other associated electrical equipment.	If the generator output is more than 15 kV then the GT and station service (auxiliary) transformer and associated equipment are included in (3.EA.1).
3.EC	Low voltage AC (600V and below – mainly 480V)	The low voltage AC system (3.EC) includes all electrical systems with voltages of 600V and below. The major components of the system are the bus bars, emergency bus bars, transformers, protective relays, relays, buses, breakers, cables, motor control centres and other associated electrical equipment.	1. Power for instrumentation, control and computer system is included in (3.ED); 2. Power for the electrical heat tracing system that provides heat to equipment containing liquid is included in (3.ED); 3. Power for lighting and motive power is included in (3.EC),

Code	Field	Description	Notes
			while the system itself is included in (3.Z).
3.ED	Vital instrumentation AC and control AC	Vital instrument control, including the computer AC power supply system, provides power to all instrumentation and equipment which requires an uninterruptible power supply. The power sources for vital instrumentation, control and computer systems are bus bars (3.EC) and the DC battery boards (3.EE), which feed the inverters (3.ED). Typical voltages would be 120V or 240V. The major components are inverters, relays, circuit breakers, cables, distribution panels, and other associated electrical equipment.	1. Power for the engineered safety features actuation system (3.IP) is included in (3.ED); 2. Power for the in-core and ex-core neutron monitoring system (3.IF) is included in (3.ED); 3. Power for the instrumentation, control and computer system is included in (3.ED).
3.EE	DC power (UPS, batteries, rectifiers, etc.)	The DC system (3.EE) provides power to all loads that must function after a loss of AC power. The major components are uninterruptible power supplies (UPS), batteries, battery chargers, rectifiers, circuit breakers, cables and distribution boards.	None
3.EF	Emergency power generation and associated auxiliaries (including fuel oil)	The emergency power generation system (3.EF) supplies medium voltage AC to essential loads during accident conditions of loss of normal on-site and off-site power. Essential loads are loads required for reactor shutdown, containment isolation, core cooling, heat removal, etc. Typically, emergency power is provided by diesel generators, although gas turbines and hydroelectric plants are also used. The major components are diesel engine (or gas turbine or hydroelectric plant), generator, fuel supply, governors, relays and cables.	1. The emergency generator lube oil system is included in (3.EF). The system that supplies water to the lube oil cooler is the essential raw cooling/service water system (3.CB); 2. The emergency fuel system, fuel oil, jacket cooling, etc. are included in (3.EF); 3. The emergency generator starting system, which provides compressed air or batteries to assist in rapid starting of the engine, is included in (3.EF);

Code	Field	Description	Notes
			4. The emergency generator building ventilation is included in (3.SE) and the fire detection system is included in (3.IB); 5. The emergency generator instrumentation and control system is included in (3.EF).
3.EG	Security and access control	The security and access control system (3.EG) controls general access to the site as well as vital areas and radiation controlled areas to prevent unauthorized access. The major components are closed circuit television, microwave and motion detection systems, identification systems (eye, hand, voice, card, etc.) and the associated instrumentation and controls.	The security and access control system is usually powered by the vital instrument AC and control AC system (3.ED). This system is normally independent of plant power supply systems.
3.EH	Communication and alarm annunciation	The communication and alarm annunciation system (3.EH) typically includes the following: (a) The communication system is provided for internal plant and off-site location communication. The system includes radio communications, normal telephone systems, hot lines to outside authorities, fax machines, and other communication systems; (b) The alarm annunciation system provides the plant personnel with alarms that indicate the onset of an abnormal condition inside the plant with respect to the safety of personnel and/or the public (on-site and off-site emergencies). The system consists of alarms, annunciations, operator interface hardware and miscellaneous equipment.	1. (3.EH) does not include the main control board indication and/or annunciation system; this is included in the plant monitoring system (3.IE); 2. The communication system between computer equipment is not included in (3.EH) but is included in (3.IA); 3. The fire detection system is included in (3.IB) and the environmental monitoring system in (3.IC).

TABLE 8. CODING FIELD 3.F: FEEDWATER, STEAM AND POWER CONVERSION SYSTEMS

Code	Field	Description	Notes
3.F	**Feedwater, steam and power conversion systems**		
	Feedwater, steam and power conversion systems direct the flow of steam to the turbine and condenser. Various functions including demineralization and cooling are also provided by these systems. These systems also provide emergency relief during reactor transients. Please note that Codes 3.FD, 3.FF, 3.FH, 3.FK, and 3.FL are unused. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.FA	Main steam and auxiliaries (including auxiliary steam)	The main steam system delivers steam to the high pressure turbine. In addition, the system supplies steam to the main feedwater turbine driven pumps, the turbine steam sealing system, the moisture separator reheaters, the steam jet air ejectors, the high pressure coolant injection steam driven turbine, the reactor core isolation cooling steam driven turbine and the auxiliary feedwater turbine driven pumps (depending on the plant design). Components for this system include flow restrictors, drains, vents, insulation, pipes and pipe supports and hangers.	1. The main steam pressure relief system for reactors which have one or more secondary loop(s) or circuit(s) is included in (3.BH); 2. The nuclear boiler overpressure protection system (BWR) is included in (3.BK); 3. The turbine bypass system is included in (3.FE); 4. The auxiliary steam system is included in (3.FA). This system generates and delivers auxiliary steam to various systems when they cannot obtain steam from the main steam system.
3.FB	Turbines (main, feedwater and auxiliary feedwater turbines, and associated auxiliaries)	Turbines (3.FB) may consist of the following systems: (a) Turbine generator system The turbine generator system includes the high pressure and low pressure turbines, generator, generator seal oil subsystem, exciter, generator stator cooling subsystem, generator hydrogen cooling subsystem, lubrication oil	1. The related part of the steam extraction system and associated auxiliaries is included in (3.FB); 2. The turbine trip signal is included in (3.ID).

Code	Field	Description	Notes
		supply system, valves, insulation, pipes and pipe supports and hangers. (b) Turbine steam sealing system The steam sealing system provides low pressure steam to the turbine shaft seals (3.FB), feedwater turbine shaft seals (3.FG), and turbine control valve seals (3.FB). Components for this system mainly include steam pressure reducers, valves and actuators, steam condensers, blowers, insulation, pipes and pipe supports and hangers. (c) Moisture separator reheater system The moisture separator reheater system receives exhaust steam from the high pressure turbine (3.FB) and removes the moisture by passing the steam through a series of baffle plates. The steam then flows over reheater tubes where it is heated by extraction steam. The dry, superheated steam is supplied to the low pressure turbines (3.FB). Components in this system are the moisture separator reheaters, insulation, pipes and pipe supports and hangers.	
3.FC	Main condenser and auxiliaries (non-condensable gases extraction and treatment)	The main condenser serves to condense the steam exhaust from the low-pressure turbines (3.FB) and the feedwater turbine driven pumps (3.FG). The main condenser also serves as a heat sink for steam flow from the turbine bypass system (3.FE).	1. The non-condensable gases extraction system (air ejector) is included in (3.FC); 2. The cooling water for the main condenser is included in (3.FN); 3. The water level of the main condenser is properly maintained by an automatic level control system (3.FC) that may send water from/to the condensate storage tank (3.CE).

Code	Field	Description	Notes
3.FE	Turbine steam by-pass to condenser	The turbine bypass system (3.FE) reduces the magnitude of a nuclear system transient following large turbine load reductions by diverting throttled steam directly to the main condenser (3.FC). This system mainly consists of the condenser steam discharge valves, other valves, pipes from the main steam header up to the condenser and pipe supports and hangers.	Steam discharges to atmosphere through relief devices from reactors that have one or more secondary loop(s) or circuit(s) are also used to reduce the magnitude of a nuclear system transient following large turbine load reductions. This system is included in (3.BH).
3.FG	Feedwater and condensate (including pumps, heat exchangers, tanks, etc.)	The condensate and feedwater system (3.FG) supplies preheated feedwater to the steam generators (3.AH) or to the reactor vessel (3.AC). Components for this system mainly include pumps (condensate, booster and main feedwater), feedwater pump turbine (for those plants that have turbine driven pumps), feedwater heaters, deaerators, drain tanks, valve and actuators, insulation, pipes and pipe supports and hangers.	1. The seal water system used for sealing is included in (3.FG); 2. The related part of the steam extraction system is included in (3.FG); 3. The thermal cycle drains and vents that accept drainage from various components in the feedwater, steam and power conversion system that vents non-condensable gases are included in (3.WG).
3.FM	Condensate demineralizer	The condensate demineralizer system (3.FM) maintains the quality of the feedwater by removing suspended impurities. Components of this system mainly include demineralizers, resin trap strainers, chemical storage tanks, cation and anion regeneration tanks, waste and crud storage tanks, resin transfer pumps, valves and actuators, insulation, pipes, pipe supports and hangers.	None
3.FN	Circulating or condenser cooling water (including raw cooling and service water)	The primary purpose of the circulating water system (3.FN) is to supply cooling water to the condensers (3.FC). In addition, (3.FN) includes the non-essential raw cooling water and service water system.	1. The circulating water system includes the cooling tower blowdown system which removes solids that concentrate in the circulating water system (3.FN) due to evaporation;

Code	Field	Description	Notes
		The major components of the circulating water system are the circulating water pumps, motors, cooling towers, large butterfly valves, travelling screens, pipes and pipe supports and hangers. The non-essential raw cooling water system provides heat removal for turbine building loads, as well as a few non-essential loads in the auxiliary building. The non-essential service water system supplies a source of water for yard watering, wash-down services and for the fire protection system.	2. Essential raw cooling water and service water systems are included in (3.CB).

TABLE 9. CODING FIELD 3.H: HEATING, VENTILATION AND AIR CONDITIONING (HVAC) SYSTEMS

Code	Field	Description	Notes
3.H	**Heating, Ventilation and Air Conditioning (HVAC) systems**		
	HVAC systems are used for assuring and maintaining consistent operable environments for both personnel and equipment by providing ventilation, air quality and temperature control. The ventilation system also helps in maintaining the radiological conditions by pressure gradient and use of appropriate filters and other related equipment. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.HA	Primary reactor containment building HVAC	The primary reactor containment building ventilation system (3.HA) provides ventilation, temperature, and air contamination control in the reactor building (primary containment in a PWR, or secondary containment in a BWR, or primary and secondary containments in double containment plant designs such as PHWRs). The system mainly consists of air handling units, valves, dampers, actuators, ductwork, filters and fans.	1. The reactor building fan cooler units are included in (3.HA); 2. The building atmospheric condition monitors are included in (3.IE) or, if used for radiation protection purposes, in (3.IH); 3. In some plant designs the ventilation system also has a pressure reduction (suppression) function. This is included in (3.HA).
3.HB	Primary containment vacuum and pressure relief	The primary containment vacuum and pressure relief system (3.HB) controls the pressure in the containment vessel, i.e. the differential pressure between the containment vessel and either the outside air or the torus (wetwell/drywell). The main components of this system are penetrations, vacuum breakers connected to the outside, diaphragms, dampers, blow-out panels and valves.	1. In BWRs, this system is called the primary containment relief system. This system protects the primary containment from exceeding the maximum external pressure and prevents backflow of suppression pool (torus) water into the drywell. Torus wetwell/drywell

Code	Field	Description	Notes
			vacuum breakers are included in (3.HB); 2. Reactor building/suppression chamber vacuum breakers are included in (3.DB); 3. In PWRs, this system is called the pressure and vacuum relief system; 4. In PHWRs, the pressure relief function to the vacuum building is included in (3.HB); 5. The pressure relief and filtration system for severe accident conditions is included in (3.HB).
3.HC	Secondary containment recirculation, exhaust and gas treatment (including BWR standby gas treatment)	The secondary containment recirculation exhaust and gas treatment system (3.HC) controls the atmosphere within the annulus of double containment NPPs and maintains these annulus areas or the secondary containment (BWR) at a negative pressure relative to the outside atmosphere. Components mainly include fans, ductwork, dampers, absolute and charcoal filters and associated equipment.	1. The emergency gas treatment system in PWRs is included in (3.HC); 2. The standby gas treatment system in BWRs is included in (3.HC); 3. The secondary containment recirculation and purge system in PHWRs is included in (3.HC).
3.HD	Drywell or wetwell HVAC and purge inerting (BWR)	The drywell or wetwell HVAC and purge inerting system (3.HD) provides ventilation and temperature control to the reactor drywell and reactor wetwell/suppression pool system (3.SA). The system mainly consists of fans, heat exchangers, ductwork and valves and actuators.	1. The containment combustible gas control system (3.DF) is independent of this system; 2. The cooling water to the heat exchanger used for cooling the containment atmosphere is supplied by

Code	Field	Description	Notes
			the component cooling water system (3.CA) or the chilled water-cooling system (3.HN).
3.HE	Reactor or nuclear auxiliary building HVAC	The reactor/nuclear auxiliary building HVAC system (3.HE) provides ventilation and temperature control to various sections of the reactor/nuclear auxiliary building (3.SC). The system mainly consists of fans, ductwork, air handling units, cooling coils, electric heaters, filters and duct hangers and supports.	The cooling water for air handling units is supplied by the chilled water system (3.HN).
3.HF	Control building HVAC (including main control room HVAC)	The control building HVAC system (3.HF) provides ventilation, heating and cooling to the control building (3.SD) including the main control room (MCR). In case of failure of the normal ventilation system to the MCR, the necessary ventilation requirement for personnel occupancy is provided by an emergency/survival ventilation system and this system is also included in (3.HF). The system mainly consists of fans, ductwork, air handling units, cooling coils, electric heaters and filters.	None
3.HG	Fuel and spent fuel buildings HVAC	The fuel and spent fuel building HVAC system (3.HG) provides ventilation and temperature control to the fuel and spent fuel building (3.SF). The system also filters air through absolute and charcoal filters before discharge to the atmosphere. The system mainly consists of fan motors, heaters, air handling units, filters, ductwork and pipes and pipe/duct hangers and supports.	The cooling water to the air handling units is supplied by the chilled water system (3.HN) or component cooling water system (3.CA).
3.HH	Turbine building HVAC	The turbine building HVAC system (3.HH) provides ventilation and temperature control to the turbine building (SG).	The cooling water to the air handling units is supplied by

Code	Field	Description	Notes
		The system mainly consists of air handling units, heaters, ductwork, fans, dampers, valves, actuators, pipes and pipe/duct hangers and supports.	the chilled water system (3.HN).
3.HK	Waste management building HVAC	The waste management building HVAC system (3.HK) provides ventilation, cooling, heating and air contamination control to the waste management building (3.SH). The system mainly consists of fans, ductwork, duct hangers, air handling units, heaters, pumps, valves and actuators.	The cooling water to the air handling units is supplied by the chilled water system (3.HN).
3.HM	Miscellaneous structures HVAC (laboratories, storage, etc.)	The miscellaneous structures HVAC system (3.HM) cools, heats or ventilates all structures not specifically identified with other ventilation systems (3.HA to 3.HK). The system mainly consists of exhaust fans, air conditioning units, air handling units, ductwork, valves and actuators, dampers, pipes and pipe/duct hangers and supports.	None
3.HN	Chilled water	The chilled water system (3.HN) provides chilled water to various air cooling coils in the ventilation systems of the drywell or wetwell (3.HD) reactor or nuclear auxiliary building (3.HE) control building (3.HF) fuel handling building (3.HG) the turbine building (3.HH) and waste management building (3.HK). The main components are pumps, motors, valves and actuators, water chiller packages, tanks, cooling coils, insulation, pipes and pipe supports and hangers.	None
3.HP	Plant stack	Exhaust air from various building ventilation systems is collected and discharged through a common plant stack (3.HP) to the atmosphere. The system mainly consists of the stack, ductwork and supports.	The radiation monitoring system used in the plant stack is included in (3.IH).

Code	Field	Description	Notes
3.HQ	Emergency generator building HVAC	Emergency generators (diesel, gas) provide essential electrical power supply to safety systems and items important to safety in case of failure of the normal power supply. The emergency generator building HVAC (3.HQ), independent of other building ventilation, is used to maintain the area temperatures. This HVAC is started automatically along with the generators.	None
3.HR	Seismic/bunkered emergency control building HVAC	In case of inhabitability of the MCR, the minimum safety functions are accomplished from the emergency control building. The HVAC of this building (3.HR) is provided by a separate set of equipment including fans, filters, ductwork, dampers and related equipment.	None

TABLE 10. CODING FIELD 3.I: INSTRUMENTATION AND CONTROL (I&C) SYSTEMS

Code	Field	Description	Notes
3.I	**Instrumentation and control (I&C) systems**		
	Instrumentation and control (I&C) systems are important to safety, particularly if a malfunction or failure could lead to radiation exposure of site personnel or the public. Examples of such I&C systems are: • The reactor protection systems; • Reactor control systems; • Systems to monitor and control normal reactor cooling; • Systems to monitor and control emergency power supplies; • Containment isolation systems. I&C Systems provide protection, control, monitoring and display and testing of safety functions. They may be either analogue or digital systems or a mixture of both (hybrid). **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.I.1	Analog I&C systems	All instrument and control systems that use a continuous variable signal and range of values to represent the information displayed are analogue. This code would be used along with other codes in this section that identifies the system that fails or malfunctions.	None
3.I.2	Digital I&C systems	All instrument and control systems that use discrete discontinuous values to represent the information displayed are digital. This code would be used along with other codes in this section that identifies the system that fails or malfunctions.	None
3.IA	Plant/process computer (including main and auxiliary computers)	The purpose of the plant/process computer system (3.IA) is to provide a quick and accurate determination of plant performance by monitoring, calculating, storing and retrieving information collected from plant instrumentation and alarms.	Reactor control and reactor protection are included in (3.IK) and (3.IN), respectively.

Code	Field	Description	Notes
3.IB	Fire detection	The fire detection system (3.IB) provides an event recording and annunciation system for fire alarms. The system mainly consists of fire detectors, alarms, annunciations and display and recording devices.	The fire protection system is included in (3.KH).
3.IC	Environment monitoring	The environment monitoring system (3.IC) provides meteorological information of plant site atmospheric conditions and detects, records and annunciates the presence of hazardous gases and the radiological conditions on the site. The system mainly consists of gas detectors, recording devices, alarms and annunciators, other miscellaneous hardware, remote sensors, signal boxes, instrument racks with associated electronic equipment and meteorological towers with instrumentation.	None
3.ID	Turbine generator instrumentation and control	The turbine generator instrumentation and control system (3.ID) provides all monitoring and control for continuous operation of the turbine generator (3.FB). This includes speed/load control, regulation of the magnetic field in the rotor of the main generator (control of the exciter) and the electro-hydraulic control system. The system's components include all instrumentation, controls and wiring.	None
3.IE	Plant and process monitoring (including main and remote/supplementary control room equipment and various remote control functions)	The plant/process monitoring system (3.IE) including the whole panel system of the control room, acquires data from the plant. It provides calculation logs, trends and historical data without any automatic control or protective action. The plant monitoring system also includes the vibration monitoring or loose part monitoring system within the primary coolant pressure boundary. This system consists of display and recording devices, operator interface hardware, vessel mounted sensors, charge converters, logic control and miscellaneous instrumentation and equipment not covered by other codes in (3.I).	1. Individual indication panels are not included in (3.IE). These panels are included in the closest related code; 2. Radiation monitors, including post-accident radiation monitors, are included in (3.IH).

Code	Field	Description	Notes
3.IF	In-core and ex-core neutron monitoring (including BWR reactor stability monitoring)	This system consists of an in-core nuclear instrumentation subsystem and an ex-core nuclear instrumentation subsystem. (a) In-core instrumentation subsystem The in-core nuclear instrumentation subsystem provides information on the neutron flux distribution used for flux tilt control and local power monitoring/control. Special neutron monitoring provided for low-power physics experiments, refuelling and criticality tests is also included in (3.IF). The main components of this system are neutron detectors (including self-powered), stability monitoring instrumentation, helical drive cable, seal table, high pressure seals, isolation valves, rotary transfer, drive wheel, drive motor, storage reel, thimbles, interface hardware and related equipment. (b) Ex-core instrumentation subsystem The ex-core nuclear instrumentation subsystem monitors the neutron flux outside the reactor vessel at all conditions from shutdown to full power or over-power excursions. These instruments are also used for reactor power monitoring and/or for reactor protection. The main components included in this subsystem are detectors and related electric circuits and wiring.	Electric power for (3.IF) is included in (3.ED).
3.IG	Leak monitoring (reactor coolant boundary, containment and auxiliary buildings)	The leak monitoring system (3.IG) provides a means of detecting abnormal leaks in the reactor coolant pressure boundary and in the containment and auxiliary buildings. The leak detection system comprises different types of instrumentation that give indications in the control room (3.IE).	Containment isolation leak control is included in (3.DB).

Code	Field	Description	Notes
3.IH	Radiation monitoring The radiation monitoring system (3.IH) monitors radiation levels in plant areas/systems (3.IH.1) and for personnel (3.IH.2). Radiation monitors used as reactor pressure boundary leak detectors are included in the leak monitoring system (3.IG). Note that the vital instrumentation AC and control AC system (3.ED) supplies the power to (3.IH). **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.IH.1	*Plant radiation monitoring*	*The plant radiation monitoring system (3.IH.1) monitors radiation or radioactivity levels on-site in specific plant areas and plant systems. It provides process information and annunciates a warning signal and an isolation signal.*	*None*
3.IH.2	*Personnel monitoring (dosimetry and contamination detection)*	*The personnel monitoring system (3.IH.2) assesses and records individual doses for plant personnel (external and internal contamination).*	*None*
3.IK	Reactor power control (including control rods and boration/dilution systems)	The reactor power control system includes the plant control systems, such as those for control rod position, primary coolant temperature, primary coolant pressure, feedwater flow, steam flow etc. The system consists of electrical circuitry, switches, indicators, alarm devices, operator interface hardware, instrumentation and controls and related equipment.	1. The feedwater control system is included in (3.IM); 2. The recirculation flow for BWR is included in (3.IL); 3. The turbine generator control is included in (3.ID); 4. Indicators in the main control room are included in (3.IE); 5. The control element assembly is included in (3.IK); 6. Electric power to this system is included in (3.ED); 7. The post-shutdown cooling/monitoring of AGRs is included in (3.IK).

Code	Field	Description	Notes
3.IL	Recirculation flow control (BWR)	The recirculation flow control system (3.IL) controls the position of the recirculation flow rate regulation valves (or speed of the variable-frequency generator). The system adjusts the reactor power level by changing the recirculation flow through the reactor core. The system consists of electrical circuitry, switchgear, electrical modules and related instrumentation and controls.	The electric power to this system is included in (3.ED).
3.IM	Feedwater control	The feedwater control system (3.IM) maintains the steam generator water level (in PWRs/PHWRs) and the reactor vessel coolant level (BWRs) within appropriate limits. The system components include electrical circuitry, controllers, instrumentation and controls and related equipment.	Electric power to this system is included in (3.ED).
3.IN	Reactor protection	The reactor protection system (3.IN) detects conditions that threaten the integrity of fuel and/or primary coolant pressure boundary and when necessary, initiates a rapid automatic power reduction or reactor shutdown. The system mainly consists of logic circuitry, remote instrumentation and operator interface hardware.	1. The reactor trip breaker is included in (3.IN); 2. Electric power to this system is included in (3.ED); 3. Some part of the Anticipated Transient Without Scram (ATWS) system that trips recirculating pumps as a secondary unit shutdown system is included in (3.IN); 4. In-core and ex-core nuclear instrumentation in the reactor protection system are included in (3.IN); 5. Manual actuation of the system is also included in (3.IM).

Code	Field	Description	Notes
3.IP	Engineered safety features actuation (including emergency systems actuation)	The engineered safety features actuation system (3.IP) monitors selected parameters and initiates automatic actuation of the system to prevent exceeding safety limits. The monitored parameter signals are connected to a logic system. When a logic condition is met an actuation signal automatically initiates the safety systems (core flooding system, containment isolation system, etc.).	Electric power to this system is included in (3.ED).
3.IQ	Non-nuclear instrumentation	This system coding is only to be used if a system cannot be readily categorized with other instrument systems.	None
3.IR	Meteorological instrumentation	The meteorological instrumentation system (3.IR) provides information on meteorological conditions on and around the plant site. The system consists of remote instrumentation, logic circuitry and operator interface hardware.	None
3.IS	Seismic instrumentation	The seismic instrumentation system (3.IS) provides information on seismic conditions on and around the plant site. The system mainly consists of remote instrumentation, logic circuitry and operator interface hardware.	None
3.IT	Vibration monitoring	The vibration monitoring system (3.IT) provides a means of detecting abnormal vibration conditions on plant equipment and infrastructure. The loose parts monitoring system is also included in (3.IT).	None
3.IU	Remote or alternate control systems	Remote or alternate control systems (3.IU) are autonomous control systems which independently perform tasks to allow operation of equipment that may be out of reach for direct operation.	None

TABLE 11. CODING FIELD 3.K: SERVICE AUXILIARY SYSTEMS

Code	Field	Description	Notes
3.K	**Service auxiliary systems**		
	Service auxiliary systems are those systems and services that are essential to continued operation of the plant but are not vital safety systems. Failure of any of these systems may cause an event. Please note that Codes 3.KA, 3.KF, 3.KK, 3.KL, 3.KM and 3.KN are unused. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.KB	Sampling (including normal and accident conditions)	The sampling system (3.KB) collects samples (during normal and accident conditions) from the reactor coolant system, recirculating water system, steam power conversion system, and related systems for chemical and radiological analyses. The system mainly consists of sample nozzles, pipes, valves and sample stations.	None
3.KC	Control and service air (non-essential) and compressed gas	The control and service air and compressed gas system (3.KC) may consist of the following two systems: (a) The control and service air system which provides dry, filtered air to components that are not important to safety. Components for this system include intake filters, air compressors, after coolers, receiver tanks, dryers, valves and actuators and pipes and pipe hangers; (b) The compressed gas system which supplies compressed gases (nitrogen, hydrogen, etc.) for safety related functions and for those that are not safety related. Components for this system mainly include gas cylinders, valve banks, compressors, dryers, filters, coolers, valves and actuators, pipes and pipe hangers.	1. The compressed air to components important to safety is included in (3.CC); 2. Electric power to this system is included in (3.EC).

Code	Field	Description	Notes
3.KD	Demineralized water	The demineralized water system (3.KD) serves as the source for all demineralized make-up water. Components for this system mainly include cation and anion removal tanks, chemical storage tanks, water storage tanks, degasifies, resin traps, pumps, valves and actuators, pipes and pipe supports and hangers.	The primary coolant purifying system is not included in (3.KD). For BWRs it is included in (3.WK), for PWR, GCR and AGR it is included in (3.BF).
3.KE	Material and equipment handling	Material and equipment handling (3.KE) includes all hoists, cranes, elevators, platforms/scaffolding, and miscellaneous machinery used for general maintenance work to load, unload, transport, handle, erect and dismantle material and equipment on the plant site.	Mobile cranes, hoists, and other similar equipment are also included in (3.KE).
3.KG	Nuclear fuel handling and storage (including both fresh and spent fuel)	The machines and equipment necessary for loading, handling and taking out the new or spent fuel assemblies are included in (3.KG). The equipment for storing the new or spent fuel assemblies and control assemblies in the spent fuel pool and handling equipment for spent fuel transport in casks are also included in (3.KG).	None
3.KH	Fire protection	The fire protection system (3.KH) serves to control and extinguish fires.	1. The source of water for the fire system is included in (3.FN); 2. The fire detection system is included in (3.IB).
3.KP	Chemical additive injection	The chemical additive injection system (3.KP) stores, transfers and injects special chemicals (ammonium hydroxide, hydrazine, sodium hypochlorite, etc.) to prevent corrosion and fouling. The main components are pumps, motors, valves and actuators, tanks, cables and associated pipes,	Boric acid injection is included in (3.BF).

TABLE 12. CODING FIELD 3.S: STRUCTURAL SYSTEMS

Code	Field	Description	Notes
3.S	**Structural systems** Structural systems within these codes are the shells/buildings, walls, ceilings, floors, supports, joists and other similar structural components. Any process equipment and pipes with associated hangers, supports, snubbers, insulation, electrical penetrations, heating ventilation or air conditioning, ductwork and cable trays in the buildings are not included in these codes. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.SA	Primary reactor containment building	The primary reactor containment building (3.SA) houses the primary structural systems enclosing the reactor installation or the main parts of it which confine the radioactive material released during a LOCA.	1. For PWRs, this can be defined as the containment building and its internal structures; 2. (3.SA) is limited to the structural system. The containment spray system, the bubble steam condenser system and containment ice condenser system are included in (3.DD); 3. For BWRs drywell, the reactor wetwell/suppression pool and the venting system (which connects the former two parts) are the main elements of this system (3.SA); 4. If the reactor building forms a secondary containment, it is included in (3.SB); 5. The containment pressure relief valve is included in (3.HB); 6. The structural part of personnel equipment transport hatches e.g. door frames is included in (3.SA) or (3.SB) depending on whether it is part of the primary or secondary

Code	Field	Description	Notes
			containment. The isolation function of personnel and equipment hatches e.g. doors and hydraulics is included in (3.DB); 7. For PHWRs, the primary containment housing the reactor and its auxiliaries and steam generator is part of 3.SA.
3.SB	Secondary reactor containment building or vacuum building (PHWR)	The secondary reactor containment building or vacuum building or the reactor building (3.SB) houses the structural systems enclosing the primary reactor containment building (3.SA) which is used as an additional barrier to confine radioactive material. This mainly consists of the containment building, ventilation system to maintain negative pressure, and associated filters/auxiliaries to limit the radioactive discharges to environment.	1. The secondary reactor containment building includes the annulus region between the primary reactor containment building and the reactor building in double containment nuclear power plants, and the reactor building structure in PWRs and BWRs; 2. For PHWRs, the vacuum building is also included in (3.SB). The pressure relief function is included in (3.HB).
3.SC	Reactor or nuclear auxiliary building	The reactor or nuclear auxiliary building is an enclosed reinforced concrete building that mainly houses: • Support systems and components that may contain radioactive liquid and gases such as the chemical and volume control system (CVCS); • High pressure and low pressure emergency core cooling systems (safety injection and RHR) and containment spray; • Emergency ventilation and filter systems; • Primary coolant polishing systems.	None
3.SD	Control building	This building houses the main control room and instrumentation cabinets, cable spreading room, control equipment room and other similar rooms.	None

Code	Field	Description	Notes
3.SE	Emergency generator building	This building may house the emergency diesel or gas turbine generators.	None
3.SF	Fresh and spent fuel buildings	N/A	None
3.SG	Turbine building	N/A	None
3.SH	Waste management building	N/A	None
3.SK	Pumping station (including cooling, make-up water, fire water, etc.)	N/A	None
3.SL	Backup ultimate heat sink building	The ultimate heat sink is provided by various means to remove decay heat when normal and emergency heat sinks have been lost. The structures containing ultimate heat sinks are included in (3.SL).	None
3.SM	Cooling towers and/or intake structure	N/A	None
3.SN	Switchyard (enclosed/open)	N/A	None
3.SP	Seismic/bunkered emergency control building	N/A	None
3.SQ	Heavy water up-gradation building (PHWR)	Heavy water that has leaked or spilled from a system or equipment becomes downgraded and must be sent for upgrading before it can be used again in a system	None
3.SR	Off-site emergency structures	Off-site facilities meant to cater to emergency scenarios	None

TABLE 13. CODING FIELD 3.W: WASTE MANAGEMENT SYSTEM

Code	Field	Description	Notes
3.W	**Waste management systems**		
	Radioactive waste occurs in a variety of forms with different physical and chemical characteristics. In addition to radioactive waste, other wastes are also produced. Both these types of wastes may occur in gaseous, liquid or solid form. The systems described in the codes below are those systems specifically designed to deal with each particular type of waste, whether radioactive or non-radioactive, and to ensure personnel and the environment are protected. **This code is not intended to be applied to a report. Use one of its subcodes.**		
3.WA	Liquid radioactive waste processing, hold-up, and discharge	The liquid radioactive waste system (3.WA) collects liquid radioactive waste streams from various plant systems and then processes them for recycling, hold-up for decay of radioactivity and discharge or disposal. The system mainly processes the primary coolant for the reuse of boric acid and reactor make-up water. This system mainly includes pumps, tanks, pipes, filters and ion exchange columns.	None
3.WB	Solid radioactive waste system	The solid radioactive waste system (3.WB) collects and processes solid radioactive wastes for on-site and off-site storage or disposal. This system mainly includes centrifuge, hopper, drums, and bailing machines.	Spent fuel elements are included in (3.KG).
3.WC	Gaseous radioactive waste hold-up and discharge system	The gaseous radioactive waste system (3.WC) collects radioactive gases from various systems, stores them in decay tanks and processes them for recycling or release. This system mainly includes pumps, hold-up tanks, pipes, and filters.	1. The plant stack system that vents processed radioactive gases to the atmosphere is included in (3.HP); 2. Control and process air for this system is included in (3.KC).

Code	Field	Description	Notes
3.WD	Non-radioactive waste (liquid, solid, and gaseous)	The non-radioactive waste system (3.WD) handles all wastes generated at the plant site that are not radioactive.	None
3.WE	Steam generator blowdown	The steam generator blowdown system (3.WE) provides a method of removing contaminants and crud from the steam generators. In addition to the normal, continuous blowdown, this system provides periodic high capacity blowdown.	None
3.WF	Plant drainage (including floor, roof, or other similar areas)	The plant drainage system (3.WF) collects the surface run-off and roof drainage that are mainly caused by precipitation.	1. The roof drainage system is included in (3.WF); 2. This system does not handle radioactive wastes.
3.WG	Equipment drainage (including vents)	The equipment drainage system (3.WG) collects radioactive and non-radioactive drainage from various sources, including floor drains throughout the plant and transports this drainage to the liquid radioactive waste system (3.WA) or the non-radioactive waste system, as appropriate (3.WD).	None
3.WH	Suppression pool clean-up	The suppression pool clean-up system (3.WH) provides a means for purifying the suppression pool water by removing radioactive iodine and other impurities. During normal power operation, it maintains the suppression pool water quality within prescribed limits. Following any evolution which releases reactor coolant to the suppression pool, the system runs continuously to reduce radiation levels inside the containment.	1. In some designs, the spent fuel pool/refuelling pool cooling/cleaning up system (3.DA) uses suppression pool clean-up filters and demineralizers. This is included in (3.DA); 2. The pressure suppression water cooling system is included in (3.DE).
3.WK	Reactor water clean-up (BWR, PHWR, LWGR etc.)	The reactor water clean-up system (3.WK) maintains the purity of the water in the reactor vessel (3.AC) and the recirculation lines (3.AG). Water purity is necessary to reduce deposition of impurities on fuel, pipes and other surfaces. In addition, this system removes water from the reactor vessel during plant startups or during level transients following a reactor scram.	None

Code	Field	Description	Notes
		The main components of this system include pumps, heat exchangers, filter/demineralizer units, precoat tanks, receiving tanks, valves and actuators, insulation, pipes and pipe supports and hangers.	

TABLE 14. CODING FIELD 3.Z: NO SYSTEM INVOLVED

Code	Field	Description	Notes
3.Z	**No system involved**		
	This code is used where no specific system is involved (e.g. human performance issues) and when a system cannot be identified or does not belong to any other code.		
3.ZA	Other systems (specified in text of IRS report)	This code is for any system that does not belong to any other code.	None

2.4. CODING FIELD 4: FAILED/AFFECTED COMPONENTS

This field identifies:

(a) The component(s) of failed or affected system(s) that failed or lost their normal function, thereby initiating or triggering further steps of the event;

(b) The important component(s) of failed or affected system(s) that failed or lost their normal function as a result of, or during the event.

The components of a nuclear power plant are divided into five main categories:

(a) Instrumentation;
(b) Mechanical;
(c) Electrical;
(d) Computers;
(e) Civil.

The appropriate code is mentioned for the failed component from the list of codes. Some failed or affected components can be categorized by more than one code. In such cases, all codes of importance are to be selected.

Suspected but not identified as the failed or affected components are also to be coded according to their category.

TABLE 15. CODING FIELD 4: FAILED/AFFECTED COMPONENTS

Code	Field
4.0	**No specific component involved**
	The code 4.0 is only to be used if no component is involved or no specific component can be identified.
4.1	**Instrumentation (gauges, transmitters, sensors, controllers, detectors, displays, etc.)**
	This code is not intended to be applied to a report. Use one of its subcodes.
4.1.0	Other (to be specified in text of IRS report)
	The code 4.1.0 is used for the instrument components that cannot be coded in any code from 4.1.1–4.1.16.
4.1.1	Pressure
4.1.2	Temperature
4.1.3	Level
4.1.4	Flow
4.1.5	Radiation/contamination
4.1.6	Chemical concentration
4.1.7	Position
4.1.8	Dewpoint, moisture
4.1.9	Neutron flux (detectors, ion chambers, and associated components)
4.1.10	Speed (rotational speed of equipment, wind speed, etc.)
4.1.11	Fire (smoke, flames, heat, etc.)
4.1.12	Hydrogen concentration
4.1.13	Electrical (current, voltage, power, etc.)
4.1.14	Vibration
4.1.15	Seismic motion
4.1.16	I&C signal

Code	Field
4.2	**Mechanical**
	Notes: 1. Welding parts are coded under 4.2.6 and/or 4.2.7. 2. 4.2.6 does not include fuel tubes; they are included in 4.2.10. **This code is not intended to be applied to a report. Use one of its subcodes.**
4.2.0	Other (to be specified in text of IRS report)
	The code 4.2.0 is used for the mechanical components that cannot be coded in any code from 4.2.1–4.2.12.
4.2.1	Pumps, compressors, fans.
4.2.2	Turbines (steam, gas, hydro), engines (diesel, gasoline, etc.).
	This code is not intended to be applied to a report. Use one of its subcodes.
4.2.2.1	*Turbines (steam, gas, hydro).*
4.2.2.2	*Engines (diesel, gasoline, etc.).*
4.2.3	Valves (including safety/relief/check/solenoid valves), valve operators, controllers, dampers and fire breakers, and seals and packing.
	This code is not intended to be applied to a report. Use one of its subcodes.
4.2.3.0	*Safety valves.*
4.2.3.1	*Relief valves.*
4.2.3.2	*Check valves.*
4.2.3.3	*Other valves.*
4.2.3.4	*Fire damper or seals.*
4.2.4	Steam generators and heat exchangers including internals.
	This code is not intended to be applied to a report. Use one of its subcodes.
4.2.4.1	*Steam generators including internals.*
4.2.4.2	*Heat exchangers including internals.*
4.2.5	Tanks, pressure vessels (reactor vessel and internals, accumulators, etc.).
	This code is not intended to be applied to a report. Use one of its subcodes.
4.2.5.1	*Fuel channel assemblies (PHWR).*

Code	Field
4.2.5.2	*Pressure vessels.*
4.2.5.3	*BWR vessel internals.*
4.2.5.4	*PWR vessel internals.*
4.2.5.5	*Tanks.*
4.2.6	Tubes, pipes, ducts.
	1. Welding parts are coded under 4.2.6 and/or 4.2.7. 2. 4.2.6 does not include fuel tubes; they are included in 4.2.10.
4.2.7	Fittings, couplings (including transmissions and gear boxes), hangers, supports, bearings, thermal sleeves, and snubbers.
	Welding parts are coded under 4.2.6 and/or 4.2.7.
4.2.8	Strainers, screens, filters, ion exchange columns.
4.2.9	Penetration (personnel access, equipment access, fuel handling, etc.).
4.2.10	Control or protective rods and associated components or mechanisms, fuel elements.
4.2.11	Fuel storage racks, fuel storage casks, and fuel transport containers.
4.2.12	Nuclear assemblies (absorber, reflectors, neutron sources, shielding equipment, etc.).
4.3	**Electrical**
	This code is not intended to be applied to a report. Use one of its subcodes.
4.3.0	Other (to be specified in text of IRS report).
	The code 4.3.0 is used for electrical components that cannot be coded in any code from 4.3.1–4.3.8.
4.3.1	Switchyard equipment (switchgear, transformer, buses, line isolators, etc.).
4.3.2	Circuit breakers, power breakers, fuses.
4.3.3	Alarms.
4.3.4	Motors (for pumps, fans, compressors, valves, motor generators, etc.).
4.3.5	Generators of emergency and stand-by power.
4.3.6	Main generators and auxiliaries.
4.3.7	Relays, connectors, hand switches, push buttons, contacts.
4.3.8	Wiring controllers, starters, electrical cables.

Code	Field
4.4	**Computers**
	This code is used for partial or total failure of computer hardware or software that has impaired the safety functions (or safety-related functions) at a nuclear power plant. Computer failures that have led to loss of assistance to the operating personnel in handling the event or retaining the data of safety significance are also to be included. **This code is not intended to be applied to a report. Use one of its subcodes.**
4.4.1	Computer hardware.
4.4.2	Computer software.
4.5	**Civil.**
	This code is not intended to be applied to a report. Use one of its subcodes
4.5.0	Other (to be specified in text of IRS report).
	Code 4.5.0 is used for civil components that cannot be coded in any code from 4.5.1–4.5.7.
4.5.1	Concrete (Including material properties).
4.5.2	Rebar, reinforcement, steel work.
4.5.3	Steel liners.
4.5.4	Pre/post stressing cables (including associated instrumentation and equipment).
4.5.5	Welds (related to civil structures).
4.5.6	Coatings, paints, etc.
4.5.7	Building penetrations, sealants (including gaskets, etc.).

2.5. CODING FIELD 5: CAUSE OF THE EVENT

This field identifies the causes of the event. Any event unfolds in stages and for each stage of the event the appropriate cause is identified. The direct/observed cause is the direct initiator of the event and/or direct trigger of the next step(s) in the event. Short term remedial actions are usually based on the direct/observed cause.

The root cause of the event is the fundamental cause or causes that if corrected will prevent re-occurrence of the event or adverse condition. In many (or most) cases, the root cause may be connected with human performance, management and/or equipment. The root cause is usually the basis for long(er) term remedial actions.

In many cases the root cause will fall in Section 5.5 “Human performance-related causal factors and root causes”. These human performance codes will usually be considered along with other root cause codes 5.6 and 5.7.

In some cases, it may be difficult to distinguish between the direct/observed cause and the root cause, in such cases both codes are used.

To help distinguish between direct/observed cause and root cause, the following examples are provided:

Example 1: Primary coolant leakage due to stress corrosion cracking in a pipe

Direct/observed causes:

5.1.1.1 Corrosion, erosion, fouling.
5.1.1.6 Leak.
5.1.1.7 Break, rupture, crack, weld failure.

Root cause:

5.7.1.2 Materials selection.

This can include the following causal factors:

- Component/material selection inadequate.

5.7.2 Equipment (procurement) specification, manufacture, storage and installation.

This can include the following causal factors:

- Material used inadequate;
- Specifications provided to manufacturer inadequate;
- Substitute parts/material used do not meet specifications;
- Installation workmanship inadequate;
- QA requirements not used or met during procurement.

Example 2: Primary coolant pump trip due to a bad contact in the breaker of the pump circuit due to insufficient maintenance.

Direct/observed cause:

5.1.2.4 Bad contact, disconnection.

Root cause:

5.7.3 Maintenance, testing or surveillance.

This can include the following causal factors:

- Corrective maintenance did not correct problem;
- Preventative maintenance inadequate;
- Maintenance performed incorrectly;
- Post maintenance testing inadequate;
- Incorrect restoration of plant following maintenance/isolation/testing.

However, if maintenance failure were due to deficiencies in maintenance procedures or deficiencies in work planning during planned /preventive maintenance, then the following codes could be used:

5.4.5 Planned/preventive maintenance.
5.5.7 Written procedures and documents.

Example 3: A control valve fails to open due to dust from the compressed air system.

Direct/observed cause:

5.1.1.8 Blockage, restriction, obstruction, binding, foreign material.

Although the foreign material (dust) might have been indicated as the direct cause of the valve failure, the more 'up-stream' cause might be a deficiency in maintenance of the compressed air system.

In this case blockage/restriction due to foreign material is a direct/observed cause, the root cause needs to be identified specifically.

Root cause:

5.7.3 Maintenance, testing or surveillance.

This can include the following causal factors:

- Corrective maintenance did not correct problem;
- Preventative maintenance inadequate;
- Maintenance performed incorrectly;
- Surveillance schedule not followed;
- Situational surveillance not performed;
- Failure to exclude foreign material.

TABLE 16. CODING FIELD 5: CAUSE OF THE EVENT

Code	Field
5.1	**Direct cause.**
	This code is not intended to be applied to a report. Use one of its subcodes.
5.1.0	Unknown.
5.1.0.1	*Other (to be specified in text of IRS report).*
5.1.1	Mechanical failure.
	This code is not intended to be applied to a report. Use one of its subcodes.
5.1.1.0	*Other mechanical failure (to be specified in text of IRS report).*
5.1.1.1	*Corrosion, erosion, fouling.*
5.1.1.2	*Wear, fretting, lubrication problem.*
5.1.1.3	*Fatigue.*
5.1.1.4	*Overloading (including mechanical stress and overspeed).*
5.1.1.5	*Vibration.*
5.1.1.6	*Leak.*
5.1.1.7	*Break, rupture, crack, weld failure.*
5.1.1.8	*Blockage, restriction, obstruction, binding, foreign material.*
5.1.1.9	*Deformation, distortion, displacement, spurious movement, loosening, loose parts.*
5.1.1.10	*Material Properties.*
5.1.2	Electrical failure.
	This code is not intended to be applied to a report. Use one of its subcodes.
5.1.2.0	*Other electrical failure (to be specified in text of IRS report).*
5.1.2.1	*Short-circuit, arcing.*
5.1.2.2	*Overheating.*
5.1.2.3	*Overvoltage or overcurrent.*
5.1.2.4	*Bad contact, disconnection.*
5.1.2.5	*Circuit failure, open circuit.*
5.1.2.6	*Ground fault.*
5.1.2.7	*Undervoltage, voltage breakdown.*
5.1.2.8	*Faulty insulation.*
5.1.2.9	*Failure to change state.*
5.1.3	Chemical or core physics failure.
	This code is not intended to be applied to a report. Use one of its subcodes.
5.1.3.0	*Other chemical failure/problem (to be specified in text of IRS report).*
5.1.3.1	*Chemical contamination (including corrosion products, anionic impurities), deposition.*
5.1.3.2	*Uncontrolled chemical reaction.*
5.1.3.3	*Core physics problems (operation outside core physics limits, including shutdown margins, reduction in reactivity worth of reactivity devices, etc.).*
5.1.3.4	*Poor chemistry or inadequate chemical control.*
5.1.4	Hydraulic/pneumatic failure.
	This code is not intended to be applied to a report. Use one of its subcodes.

Code	Field
5.1.4.0	*Other hydraulic/pneumatic failure (to be specified in text of IRS report).*
5.1.4.1	*Water hammer, pressure fluctuations, over pressure.* *(5.1.4.1 is pressure acting from inside of the equipment).*
5.1.4.1.1	*Water hammer.*
5.1.4.1.2	*Pressure fluctuations, over pressure.*
5.1.4.2	*Loss of fluid flow.*
5.1.4.3	*Loss of pressure.*
5.1.4.4	*Cavitation.*
5.1.4.5	*Gas binding and pressure locking.*
5.1.4.6	*Moisture in air systems.*
5.1.4.7	*Vibration due to fluid flow.*
5.1.5	Instrumentation and control failure. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.1.5.0	*Other instrumentation and control failure (to be specified in text of IRS report).*
5.1.5.2	*False response, loss of signal, spurious signal.*
5.1.5.3	*Oscillation.*
5.1.5.4	*Set point drift, parameter drift.*
5.1.5.5	*Computer hardware deficiency.*
5.1.5.6	*Computer software deficiency.*
5.1.5.7	*Electromagnetic and/or radiofrequency interference.*
5.1.5.8	*I&C circuit board deficiencies.*
5.1.6	Environmental (abnormal conditions inside the plant). **This code is not intended to be applied to a report. Use one of its subcodes.**
5.1.6.0	*Other internal environmental cause (to be specified in text of IRS report).*
5.1.6.1	*High temperature.*
5.1.6.2	*Pressure.* *(5.1.6.2 is pressure acting on the equipment from the outside).*
5.1.6.3	*Humidity.*
5.1.6.4	*Flooding, water ingress.*
5.1.6.5	*Low temperature, freezing.*
5.1.6.6	*Radiation, contamination, irradiation of parts.*
5.1.6.7	*Dropped loads, missiles, high energy impacts.*
5.1.6.8	*Fire, burning, smoke, explosion.*
5.1.7	Environmental (external to the plant). **This code is not intended to be applied to a report. Use one of its subcodes.**
5.1.7.0	*Other external environmental cause (fire, toxic/explosive gasses, etc. – to be specified in text of IRS report).*
5.1.7.1	*Lightning strikes.*
5.1.7.2	*Flooding.*
5.1.7.3	*Storm, wind loading.*
5.1.7.4	*Earthquake.*
5.1.7.5	*Freezing.*
5.1.7.6	*High ambient temperature.*
5.1.7.7	*Heavy rain or snow.*
5.1.7.8	*Biological fouling.*

Code	Field
5.1.7.9	*High or low cooling water level (sea, lake, river, etc.).*
Note: No codes for 5.1.8 and 5.1.9	
5.1.10	Human factors. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.1.10.1	*Slip or lapse.*
5.1.10.2	*Mistake.*
5.1.10.3	*Violation.*
5.1.10.4	*Sabotage.*
Note: No codes for 5.2	
5.3	**Plant staff or organisations involved** **This code is not intended to be applied to a report. Use one of its subcodes.**
5.3.1	Licensee. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.3.1.1	*Maintenance.*
5.3.1.2	*Operations.*
5.3.1.3	*Technical and engineering.*
5.3.1.4	*Management and administration.*
5.3.1.5	*Control of contractor/sub-contractor/vendor.*
5.3.2	Contractor, Sub-contractor. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.3.2.1	*On-site contractor or sub-contractor.*
5.3.2.2	*Off-site manufacturer or sub-contractor.*
5.3.3	Vendor.
5.3.4	Designer.
5.3.5	Other (to be specified in text of IRS report).
5.3.6	Supply chain
5.4	**Type of activity** **This code is not intended to be applied to a report. Use one of its subcodes.**
5.4.1	Not relevant.
5.4.2	Normal operations.
5.4.3	Shutdown operations.
5.4.4	Equipment startup.
5.4.5	Planned/preventive maintenance.
5.4.6	Isolating/de-isolating (clearance and tagging of mechanical and electrical systems).
5.4.7	Unplanned or corrective maintenance.
5.4.8	Routine testing with existing procedures/documents. This code is used for routine testing either performed frequently or infrequently where procedures already exist.
5.4.9	Special testing with a specific procedure. This code is used where a procedure is specifically produced to perform the testing even if the testing may be carried out regularly.
5.4.10	Post-modification testing.

Code	Field
5.4.11	Post-maintenance testing.
5.4.12	Fault finding.
5.4.13	Construction, installation, and commissioning (of new equipment, system, or complete plant).
5.4.14	Return to service (of existing equipment).
5.4.15	Decommissioning.
5.4.16	Fuel handling/refuelling operations.
5.4.17	Inspection.
5.4.18	Abnormal operation (due to external or internal constraints).
5.4.19	Engineering (design or field engineering) review.
5.4.20	Modification implementation.
5.4.21	Training.
5.4.22	Actions taken under emergency conditions.
5.4.23	Other activity (to be specified in text of IRS report).
5.4.24	Inspections, tests, analysis, acceptance criteria (ITAAC) – for new reactor construction.
5.4.25	Welding (on-site).
5.4.26	Manufacturing (off-site).
5.4.27	Concrete pouring.
5.4.28	Start-up operations
5.4.29	Inservice inspection
5.5	**Human performance related causal factors and root causes** **This code is not intended to be applied to a report. Use one of its subcodes.**
5.5.1	Verbal communications.
5.5.2	Personnel work practices. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.5.2.0	*Others (to be specified in text of IRS report).*
5.5.2.1	*Control of task/independent verification.*
5.5.2.2	*Complacency/lack of motivation/inappropriate habits.*
5.5.2.3	*Use of improper tools and equipment.*
5.5.2.4	*Self-check practices (including Stop, Think, Act, Review (STAR), etc.).*
5.5.2.5	*Questioning attitude, dealing with uncertainty (assumed/implied greater competence of or influence from more experienced personnel).*
5.5.3	Personnel work scheduling (including workload, work time provided).
5.5.4	Environmental conditions.
5.5.5	Man-machine interface. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.5.5.1	*Alarm control and maintenance practices.*
5.5.5.2	*Equipment/controls labelling.*
5.5.6	Training/qualification.
5.5.7	Written procedures and documents. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.5.7.1	*Procedure availability.*
5.5.7.2	*Procedure completeness/accuracy.*
5.5.7.3	*Procedure compliance.*

Code	Field
5.5.7.4	*Documentation management (including archiving and retention).*
5.5.7.5	*Verification and/or validation of procedures*
5.5.8	Supervisory methods (standard setting, emphasis of safe work practices and questioning attitude, self-checks, etc.).
5.5.9	Work organization. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.5.9.0	*Others (to be specified in text of IRS report).*
5.5.9.1	*Shift/team size or composition.*
5.5.9.2	*Planning/preparation of work (work package planning, pre-job briefings, shift turnover practices, etc.).*
5.5.10	Personal factors. **This code is not intended to be applied to a report. Use one of its subcodes.**
5.5.10.0	*Others (to be specified in text of IRS report).*
5.5.10.1	*Fitness for work (fatigue, illness, etc.).*
5.5.10.2	*Stress/perceived lack of time/boredom (including imposition of parallel and/or unexpected tasks).*
5.5.10.3	*Skill of the craft less than adequate/not familiar with job performance standards (including task difficulty).*
5.5.11	Use of operating experience.
5.5.12	Event investigation (insufficient analysis, deficiencies in quality, timeliness of the analysis, extent of condition/cause not investigated, etc.).
5.6	**Management related causal factors and root causes** **This code is not intended to be applied to a report. Use one of its subcodes.**
5.6.0	Other (to be specified in text of IRS report).
5.6.1	Management direction. **This code is not intended to be applied to a report. Use one of its subcodes**.
5.6.1.1	*Existence of policies, standards, expectations.*
5.6.1.2	*Communication/enforcement of policies, standards, expectations.*
5.6.1.3	*Production pressure or perceived pressure.*
5.6.1.4	*Clarity of responsibility.*
5.6.2	Communication or co-ordination.
5.6.3	Management involvement, monitoring, and assessment.
5.6.4	Decision process.
5.6.5	Allocation of resources (planning and prioritization relative to safety, etc.).
5.6.6	Change management.
5.6.7	Safety culture.
5.6.8	Management of contingencies (alternate plans of action, etc.).
5.6.9	Management of contracted work (qualification, training, supervision and guidance, etc.).
5.6.10	Management of staff training and qualification.
5.6.11	Knowledge management.
5.6.12	Maintenance programme
5.6.13	Procedure quality

Code	Field
5.6.14	Aging management programme
5.6.15	Accident management
5.7	**Equipment related causal factors and root causes**
	This code is not intended to be applied to a report. Use one of its subcodes.
5.7.0	Others (to be specified in text of IRS report).
5.7.1	Design configuration and analysis.
	This code is not intended to be applied to a report. Use one of its subcodes.
5.7.1.1	*Design analysis quality.*
5.7.1.2	*Materials selection.*
5.7.1.3	*Modifications engineering quality.*
5.7.1.4	*Modifications engineering review process.*
5.7.2	Equipment or procurement specification, manufacture, storage, and installation.
	This code is not intended to be applied to a report. Use one of its subcodes.
5.7.2.1	*Receipt inspection.*
5.7.2.2	*Parts/consumables shelf life/storage controls.*
5.7.2.3	*Installation and commissioning.*
5.7.3	Maintenance, testing, or surveillance.
	This code is not intended to be applied to a report. Use one of its subcodes.
5.7.3.1	*Foreign material exclusion controls.*
5.7.3.2	*Parts and consumables selection/use.*
5.7.3.3	*Control of temporary devices.*
5.7.4	Equipment environmental qualification.
5.7.5	Equipment aging.
5.7.6	Counterfeit, suspect, or fraudulent items (CFSI).
5.7.7	Equipment obsolescence (obsolescent design).
5.7.8	Marking/labelling of plant equipment (rooms, systems, components, or controls).
5.7.9	Dedication.
5.7.10	Seismic Qualification

2.6. CODING FIELD 6: EFFECTS ON OPERATION

This field identifies the results of a manual or automatic operational response of the plant such as a scram or a load reduction due to the occurrence of an event. It also identifies the activation of any safety system, the challenge of safety or relief valves, the release of radioactivity or the exposure of people and the exceeding of technical specifications or operational limits as a result of an event.

The fields given are mostly self-explanatory such as reactor scram (auto/manual), controlled shutdown, etc. An explanation is provided where deemed necessary.

TABLE 17. CODING FIELD 6: EFFECTS ON OPERATION

Code	Field
6.0	**No significant effect on operation or not relevant.**
6.1	**Reactor scram.**
	This code is not intended to be applied to a report. Use one of its subcodes.
6.1.1	Automatic reactor scram.
6.1.2	Manual reactor scram.
6.2	**Controlled shutdown.**
6.3	**Load reduction.**
	This code is not intended to be applied to a report. Use one of its subcodes.
6.3.1	Automatic load reduction.
6.3.2	Manual load reduction.
6.4	**Activation of engineered safety features.**
	This code includes not only the activation of a safety feature but also the actuation of safety-related signals (safety injection, containment isolation, etc.).
6.5	**Challenge to a safety or relief valve.**
	This code is not intended to be applied to a report. Use one of its subcodes.
6.5.1	Challenge to a safety or relief valve in the primary circuit.
6.5.2	Challenge to a safety or relief valve in the steam or condensate cycle.
6.6	**Unanticipated or significant release of radioactive material.**
	This code is not intended to be applied to a report. Use one of its subcodes.
6.6.1	Unanticipated or significant release of radioactive material outside the plant. Code 6.6.1 is selected even if the release level of radioactive material is lower than the regulatory limits when the release occurred as a result of an event rather than as a result of planned operation.
6.6.2	Unanticipated or significant release of radioactive material inside the plant. Code 6.6.2 is selected if a certain amount of radioactive material leaked but the radioactivity remained confined inside the plant.
6.7	**Unplanned or significant radiation exposure of personnel or public.**
	Code 6.7 is selected even if the exposure level is lower than the regulatory limits.
6.8	**Personnel or public injuries.**
6.9	**Outage extension.**
6.10	**Exceeding technical specification limits.**
6.11	**House load or island operation (plant continues to operate supplying only its own loads).**
6.12	**Actual or potential delay in initial startup.**

Code	Field
6.13	**Actual or potential impact on the lifetime of the plant.**
6.14	**Actual or potential impact on existing nuclear facilities located nearby.**
6.15	**Worsening of operational conditions.**
6.16	**Reduction of safety margins.**

2.7. CODING FIELD 7: CHARACTERISTICS OF THE EVENT/INFORMATION

This field identifies the nature of the event in relation to the reporting categories, in a manner similar to the relationship between direct/observed causes and root causes.

The characteristic of the event describes in a few words, the trigger or nature of the event (often found in the title of the event) whereas the reporting categories indicate the areas of concern, where lessons can be learned, or the outcomes of the event.

The codes given are mostly self-explanatory, such as ‘fuel handling event’. An explanation is provided where deemed necessary.

TABLE 18. CODING FIELD 7: CHARACTERISTICS OF THE EVENT/INFORMATION

Code	Field
7.0	**Other characteristics (to be specified in text of IRS report).** This code is used if the event cannot be coded in any other code from 7.1–7.17.
7.1	**Degraded fuel.** Even if the fuel cladding has not ruptured but the fuel is affected, 7.1 is to be selected.
7.2	**Degraded reactor coolant boundary.** For any abnormal leak or crack in the pressure boundary, even if small, 7.2 is to be selected. However, if there is a failure inside the pressure boundary, but the integrity of the boundary is not affected, code 7.2 is not appropriate.
7.3	**Degraded reactor containment.** This code is used for any failure of the containment function (ventilation, airlocks/hatches, isolation valves etc.).
7.4	**Loss of safety function.** Loss of safety function means total loss of one safety function. Total loss of a safety function means complete failure of all redundant and diverse safety systems associated with that one function.
7.5	**Significant degradation of safety function.** This code is to be used only when a failure leading to significant degradation of a safety function does not fully affect the safety function.
7.6	**Failure or significant degradation of the reactivity control.** This code is mainly related to a failure or degradation of the control rod drives (primary shutdown system) or secondary shutdown system. For BWRs, the recirculation system failure is included in 7.6 and 7.7.
7.7	**Failure or significant degradation of plant control.** This code includes several types of events in which the plant control was affected, requiring that the plant be shut down, automatically or manually.
7.8	**Failure or significant degradation of heat removal capability.** This code includes several types of events in which the heat removal capacity from the reactor core was significantly affected. A small leak in the primary coolant pressure boundary is not included in 7.8 but is included in 7.2.
7.9	**Loss of off-site power.**

Code	Field
	This code means the loss of all high voltage power supply from external lines. In such a situation the power supply from the generator to station auxiliaries through the station auxiliary transformer and/or from emergency diesel generators will be available.
7.10	**Loss of on-site power.** This code covers a complete loss of, or a significant degradation of on-site power. Power loss in only one bus is coded as 7.10. A partial loss of the emergency diesel generator or battery power supply, even if it is not necessary in the situation, is also to be coded as 7.10.
7.11	**Transient.** Transients, regardless of their origin from the primary or secondary side, are included in the following codes. **This code is not intended to be applied to a report. Use one of its subcodes.**
7.11.0	Other transient (to be specified in text of IRS report).
7.11.1	Power transient. Code 7.11.1 implies a power excursion.
7.11.2	Temperature transient.
7.11.3	Pressure transient.
7.11.4	Flow transient.
7.12	**Physical hazards (internal or external to the plant).** Hazards such as flooding, fire, high winds, etc., are included here. Security related events are included in 7.16.
7.13	**Discovery of major condition not previously considered or analyzed.**
7.14	**Fuel handling event.**
7.15	**Radioactive waste event.**
7.16	**Security, safeguards, sabotage, or tampering event.**
7.17	**Construction/manufacturing deficiencies.**

2.8. CODING FIELD 8: NATURE OF FAILURE OR ERROR

This field identifies the failure mode(s) that play the major role in an event. Failure may include physical impairment and/or functional loss. The terms: 'single failure' or 'common cause failure' are not limited to redundant systems only. The field also includes significant or unforeseen interactions between systems or between a system and its environment.

'Failure' refers to physical impairment and/or unavailability of plant equipment. 'Error' refers to human error or inadequate human action.

TABLE 19. CODING FIELD 8: NATURE OF FAILURE OR ERROR

Code	Field	Notes
8.0	**Not relevant.**	This code is used where no specific component failure can be identified and where no other code in this section is relevant.
8.1	**Single failure or single error.**	This code is used for a random failure that results in the loss of capability of a component to perform its intended function.
8.2	**Multiple failures or multiple errors.**	This code is used for the failure of several components to perform their intended function even if this is caused initially by the failure of one single component. Multiple failures may be either independent or dependent multiple failures. **This code is not intended to be applied to a report. Use one of its subcodes.**
8.2.1	Independent multiple failures or errors.	This code is used if, within one event, two or more occurrences (failures, errors) took place with different causes and where one occurrence is not a logical or technical consequence of another one.
8.2.2	Dependent multiple failures or errors.	This code is used if, within one event, two or more occurrences (failures, errors) took place with different causes but one occurrence is a consequence of another occurrence, such as: • Shared equipment dependencies where one system is a support system for other systems; • Functional dependencies where the function of one system depends on the function of another system;

Code	Field	Notes
		Physical interaction dependencies where environmental effects caused by a failure (e.g. flooding after a pipe break) results in failure of other equipment.
8.2.3	Recurrent failure or error.	This code is used if the same or similar failure occurred due to the same cause in more than one event in either the same plant or different plants.
8.3	**Common cause failure (including potential for a common cause failure).**	This code is used when the same single cause gives rise to multiple failures, i.e. two or more identical or similar components fail due to the same cause. Consequential failures from a single cause are coded as multiple failures (8.2).
8.4	**Significant or unforeseen interaction between systems.**	This code is used when there is a significant or unforeseen interaction between several systems e.g. the operation of an emulsifier system which might cause a short circuit in another safety system needed to control the event. Interactions between systems include the interaction between the environment and plant equipment, i.e. due to frost, condensation, humidity, etc.
8.5	**Generic (more than one reactor).**	None

2.9. CODING FIELD 9: RECOVERY ACTIONS

This field identifies the activities taken to terminate/recover the event and to bring the plant to a safe state. More than one code can be used. 'Failure' means physical impairment and/or unavailability of plant equipment. 'Error' means human error or inadequate human action.

Table 20. CODING FIELD 9: RECOVERY ACTIONS

Code	Field	Notes
9.0	**Not relevant.**	This code is used where no specific recovery action can be identified and/or where no other code in this section is relevant.
9.1	**Recovery by human action.**	Human recovery actions are those effective actions taken by plant personnel to terminate the event in response to equipment failures, inadequate human actions and plant transients. Recovery may be by foreseen or unforeseen human actions as explained below. **This code is not intended to be applied to a report. Use one of its subcodes.**
9.1.1	Recovery by foreseen human action (procedures and instructions/guidelines available and used, training prepared the operators to respond, etc.)	Foreseen human recovery actions means recovery actions taken by plant personnel, which are directed by operating procedures, (e.g. planned surveillance, transient response procedures, etc.) guidance, training, etc.
9.1.2	Recovery by unforeseen human action (new actions or actions outside the procedures required, inadequate or non-existent training, etc.).	Unforeseen human recovery actions are those recovery actions taken by plant personnel in response to observed failures, errors, transients, etc., which are not prescribed/directed by operating procedures, documents, instructions, guidance or training.
9.2	**Recovery by automatic plant action or by design.**	Recovery by automatic plant action or by design is where the event has been halted or where the plant has been returned to a safe state by means of automatic plant response or by system plant design e.g. automatic operation of the emulsifier fire protection system.
9.3	**No recovery.**	This code is to be used along where no recovery of the event has been made either by automatic plant action or by human intervention. In this case the event has usually been allowed to run its course. This code can also be used when the report has been issued prior to recovery of the event.

3. EXAMPLES OF CODING

EXAMPLE 1: FAILURE TO CORRECT A TEMPORARY (TEST) CONFIGURATION THAT PRECLUDES A SWITCH OF THE SAFETY INJECTION SYSTEM TO RECIRCULATION MODE

Summary of the event

During the refuelling outage of a PWR unit, a plant operator performed a safety injection (SI) test with the vessel open and the core unloaded. To perform this task, it was necessary for the operator to install a temporary shunt and disconnect two wires to simulate closure of the automatic reactor trip breakers (RTBs).

One year later, during the next outage, the operator detected a malfunction while testing reactor protection system relays. The two wires previously disconnected to simulate RTB closure during the safety injection test with vessel open/core unloaded were found still to be disconnected. The original work request contained ambiguities that resulted in a second operator, who was returning the system to its initial configuration, failing to identify that the RTB wires simulating closure were still disconnected.

This temporary configuration performed during the earlier SI test, prevented the ‘RTB open’ confirmation signal from being initiated as would normally occur in the safety injection sequence. Without receipt of this signal the safety injection signal will not be reset and prevents the SI system switching to recirculation mode.

During this period of disconnection, no accident occurred that would have needed the safety injection system. Thus, the temporary configuration still in place had no direct impact on safety. However, during this period, a large or intermediate-break LOCA or a steam generator tube rupture would have had a significant impact on safety. If such an incident were to occur, it was identified that the probability of core damage would be very high. This incident was classified level 1 on the INES scale.

Reporting categories

1.2.5 Degradation of systems required to assure primary coolant inventory and core cooling.

(Code 1.2.5 has been applied since there was degradation in the safety-related system which could have impaired core cooling).

1.3.3 Deficiencies in operation (including maintenance and surveillance).

(During the original SI test an error by the operating personnel resulted in the temporary disconnection not being removed once the work was completed resulting in loss of plant capability to perform safety functions).

1.6 Events of potential safety significance.

(There was no immediate impact on safety, however, if certain plant conditions had needed these safety systems to operate, there could have been a potentially significant event).

Plant status prior to the event

2.3.2.2 Refuelling or open vessel - all fuel out of the core.

(The safety injection test was being performed during a refuelling outage with all the fuel unloaded).

2.5 Testing or maintenance being performed.

(The temporary disconnection which was not reconnected was carried out during a safety injection test).

Failed/affected systems

3.IN Reactor protection.

(The system that failed was the reactor trip breaker (RTB) because the RTB open signal did not operate. The RTB is part of reactor protection. Only those systems that failed or lost their normal function are coded. Code 3.BG (Emergency Core Cooling, Essential Auxiliary Systems) is not applicable as the safety injection system did not fail).

Failed/affected components

4.3.2 Circuit breakers, power breakers, fuses.

(This code was chosen because even though the breaker did not fail it could perform its intended function).

4.3.8 Wiring, controllers, starters, electrical cables.

(The event occurred due to disconnection of electrical wiring in a safety circuit).

Cause of event

5.1.2.4 Bad contact, disconnection.

(See 4.3.8)

5.3.1.2 Operations.

(The operating personnel failed to return the system to its normal operational state).

5.4.8 Routine testing with existing procedures/documents.

(Code 5.4.8 was chosen because the event occurred during periodic testing using an existing standard work request. 5.4.9 would have been be applicable if the procedure were specifically written to perform this as a special test).

5.5.2 Personnel work practices.

(The operator failed to check that the reconnection of the RTBs had been made. Other codes in 5.5.2 could have also been used, such as 5.5.2.4, if further information had been available to allow for this).

5.5.7.2 Procedure completeness/accuracy.

(There were ambiguities in the work request).

5.5.9.2 Planning/preparation of work.

(For example, work planning, pre-job briefings, shift turnover practices. One operator commenced the SI test and a second returned the plant to its original configuration. As no further information was available to allow for coding no code under section 5.6 has been used).

5.7.3 Maintenance, testing or surveillance.

(The event occurred during periodic testing of the safety injection systems).

Effects on operation

6.0 No significant effect on operation or not relevant.

(There was no immediate impact on operation as there was no significant event; however, if certain plant conditions had needed these safety systems to operate, potentially there could have been a significant event).

Characteristics of the event/information

7.5 Significant degradation of safety function.

(This code is applicable because only part of the safety function was impaired. Code 7.4 would be used if there was a total loss of the safety functions in one system).

Nature of failure or error

8.1 Single failure or single error.

(Used because the event occurred due to one failure e.g. the RTB signal wires being disconnected).

Nature of recovery actions

9.1.1 Recovery by foreseen human action.

(Manual reconnection of the disconnected wires and amendment of the procedures by the operating personnel in line with normal procedures, instructions, guidance and training).

EXAMPLE 2: FOREIGN OBJECTS FOUND IN A STEAM GENERATOR ‘COLD’ HEADER DURING SCHEDULED MAINTENANCE OUTAGE

Summary of the event

During a scheduled maintenance outage on the nuclear power plant unit and in the course of closeout inspection following Steam Generator 2 cold header maintenance, the following foreign materials were found:

- M4x8 mm stainless steel bolt;
- 15x2 mm piece of plastic clamp;
- two 10x10mm pieces of black reinforced hose;
- Undetermined particulate.

On completion of the examination, all the above objects were removed from the header. No breach of operational limits and conditions occurred.

The foreign objects fell into the SG-2 ‘cold’ header from a maintenance platform during SG-2 repair works; no need for maintenance plugs for the header was identified to avoid foreign material intrusion. Contractors and operating personnel were allowed to work unsupervised during the maintenance work. Maintenance documentation did not identify the need for a risk assessment or the actions necessary to avoid foreign material intrusion into the primary circuit during activities performed on depressurized components of the reactor installation.

Reporting categories

1.3.3 Deficiencies in operation (including maintenance and surveillance).

(This code was applied because the event was caused due to personnel errors during maintenance work).

1.4 Generic Problems of Safety Interest.

(This code indicates the event is of generic interest because of the applicability of foreign material exclusion).

1.6 Events of potential safety significance.

(The event was identified before closing the header which avoided any significant consequences).

Plant status prior to the event

2.3.1 Cold shutdown with closed reactor vessel.

(The unit was undergoing a scheduled maintenance outage).

Failed/affected systems

3.AH Steam generator, boiler, steam drum.

Failed/affected components

4.2.4.1 Steam generators including internals.

(This code comes under 4.2.4 but specifically is used because the affected component is only the steam generator).

Cause of event

5.1.1.8 Blockage, restriction, obstruction, binding, foreign material.

(Direct/observed cause).

5.1.10.1 Slip or lapse.

(Contractors and plant personnel failed to maintain a clean work area during the maintenance work to prevent foreign material intrusion).

5.3.1.1 Maintenance.

(Maintenance personnel performed the work).

5.3.1.4 Management and administration.

(Failure of managers to adequately supervise and control the work).

5.3.1.5 Control of contractor/sub-contractor/vendor.

(Failure to adequately supervise and control contractors).

5.4.5 Planned/preventive maintenance.

(This was the activity being performed).

5.5.7.2 Procedures completeness and accuracy.

(The procedures and work control documents did not identify the actions needed to avoid foreign material intrusion).

5.7.3.1 Foreign material exclusion controls.

Effects on operation

6.0 No significant effect on operation or not relevant.

(The loop was isolated from the rest of the reactor cooling system so therefore there was no effect on general operations).

Characteristics of the event/information

7.0 Other characteristics (to be specified in text of IRS report).

(The event does not fall in any other code for characteristics of the incident).

Nature of failure or error

8.1 Single failure or single error.

(Used because the event occurred due to one failure e.g. foreign material intrusion into the SG header. Even though on four separate occasions foreign material entered the header, the cause was the same).

Nature of recovery actions

9.1.1 Recovery by foreseen human action.

(Manual removal of foreign material from SG header was carried out as per procedures, and the operating procedures were amended to include actions to prevent foreign material intrusion during maintenance in accordance with plant instructions).

EXAMPLE 3: REACTIVITY EXCURSION AFTER CATION-BED DEMINERALIZER PLACED IN SERVICE BEFORE BEING CONDITIONED

Summary of the event

The cation bed demineralizer/ion exchanger on the reactor primary circuit letdown line was placed in service for 10 minutes after the PWR Unit returned from outage. After 12 minutes the reactor operators noticed the reactor coolant temperature was higher than normal. The shift chemist was contacted and he confirmed that in accordance with his training, he had requested the control room to place the demineralizer in service for 10 minutes. At the time he was unaware of a need to condition the demineralizer by flushing before placing it in service after a unit outage. The plant chemist had anticipated that the demineralizer would only be needed to be placed in service later that week and had not left any written instructions for the duty shift chemist on the conditioning if the demineralizer needed to be placed in service. Additionally, procedures for the use of the demineralizer/ion exchanger did not identify this. Although the resultant change in reactor coolant temperature was small, the event led to an unexpected reactivity excursion.

Reporting categories

1.2.4 Degradation of systems required to control reactivity.

(The event led to a reactivity excursion hence the use of this code. The demineralizer/ion exchanger while part of water chemistry is important for reactivity control).

Plant status prior to the event

2.1.3 Raising power or starting up.

(The unit was under startup).

Failed/affected systems

3.BF Chemical and volume control (PWR with main pumps shaft seal water, etc.).

(Code 3.BF was used because it pertains to water chemistry on the letdown lines of the primary circuit. Code 3.AA was not chosen because it pertains to the component and not the reactivity).

Failed/affected components

4.2.8 Strainers, screens, filters, ion exchange columns.

(Code 4.2.8 was chosen because the ion exchange column/demineralizer was the affected component).

Cause of event

5.1.3.4 Poor chemistry or inadequate chemical control.

(Direct cause: Flushing of the system was not carried out resulting in poor chemistry).

5.1.10.2 Mistake.

(The person performing the task made the error because his understanding of the task was inadequate).

5.3.1.2 Operations.

(The shift chemist is part of operations).

5.4.4 Equipment startup.

(Demineralizer was put into operation).

5.5.1 Verbal communications.

(Failure of the plant chemist to ensure all responsible persons involved with the system were aware of all the necessary actions).

5.5.6 Training/qualification.

(The shift chemist's training had not included the need to condition the demineralizer/ion exchanger prior to being put into service after a unit outage).

5.5.7.2 Procedure completeness/accuracy.

(The need to condition the demineralizer/ion exchanger prior to being put into service after a unit outage was not included in the procedures on operation of the demineralizer/ion exchanger).

5.5.10.3 Skill of the craft less than adequate/not familiar with job performance standards.

(The shift chemist was not aware of the need to condition the demineralizer/ion exchanger prior to being put into service after a unit outage).

Effects on operation

6.0 No significant effect on operation or not relevant.

(Although there was a small reactivity excursion there were no significant effects on any other operation, hence Code 6.0 was chosen. Code 6.10 is used if there is evidence of exceeding a technical specification limit).

Characteristics of the event/information

7.6 Failure or significant degradation of the reactivity control.

(This code was used because of the reactivity excursion due to failure in reactivity control).

Nature of failure or error

8.2.1 Independent multiple failure or errors.

(Several failures led to this event, hence the use of this code. These failures were not connected with each other. i.e. the plant chemist not communicating the necessary actions, training inadequate of shift chemist, etc.).

Nature of recovery actions

9.1.1 Recovery by foreseen human actions.

ANNEX I - LIST OF REACTOR TYPES AND COUNTRY CODES

REACTOR TYPES

BWR	Boiling Water Reactor
FBR	Fast Breeder Reactor
GCR	Gas Cooled Reactor (graphite or heavy water moderated; includes AGR, HTGR and HWGCR)
HWLWR	Heavy water moderated, boiling light water cooled reactor
LWGR	Light water cooled, graphite moderated reactor (e.g. RBMK)
PHWR	Heavy water moderated, pressure tube reactor
PWR	Pressurized water reactor (includes WWER)
SGHWR	Steam generating heavy water reactor
OTHER	Other type of reactor

COUNTRY CODES

AE	United Arab Emirates
AM	Armenia
AR	Argentina
BE	Belgium
BG	Bulgaria
BY	Belarus
BR	Brazil
CA	Canada
CH	Switzerland
CN	China
CZ	Czech Republic
DE	Germany
ES	Spain
FI	Finland
FR	France
GB	United Kingdom
HR	Croatia
HU	Hungary
IN	India
IR	Iran
IT	Italy
JP	Japan
KR	Republic of Korea
LT	Lithuania
MX	Mexico
NL	Netherlands
PK	Pakistan
PL	Poland
RO	Romania
RU	Russian Federation
SE	Sweden
SL	Slovenia
SK	Slovakia
TR	Turkey
UA	Ukraine
US	United States of America
ZA	South Africa

ANNEX II - ABBREVIATIONS FOR USE IN IRS REPORTS

(Abbreviations may be used in IRS reports after the applicable term or phrase has first been written in full (e.g., Steam Generator 2 (SG2)).

ADS	automatic depressurization system
ADV	atmospheric dump valve
AGR	advanced gas cooled reactor
A/E	architect engineer
AFW	auxiliary feedwater
APRM	average power range monitor
ASP	accident sequence precursor
ATWS	anticipated transient without scram
BDT	boron dilution tank
BIT	boron injection tank
BOP	balance of plant
CCIAS	concurrent containment isolation actuation signal
CCP	centrifugal charging pump
CCWS	component cooling water system
CIAS	containment isolation actuation signal
CPCS	containment pressure control system
CRD	control rod drive
CRDI	control room distribution inverter
CREF	control room emergency filtration
CRPI	control rod position indicator
CSS	containment spray system
CVCS	chemical and volume control system
DNB	departure from nucleate boiling
ECCS	emergency core cooling system
EDG	emergency diesel generator
ESF	engineered safety feature
ESFAS	engineered safety feature actuation signal
ESW	emergency service water system
FCV	feedwater control valve
FWIV	feedwater isolation valve
FWP	feedwater pump
GCB	generator circuit breaker
GT	generator transformer/main transformer
HGTR	high temperature gas cooled reactor
HPCI	high pressure coolant injection
HPSI	high pressure safety injection
HVAC	heating, ventilation and air conditioning
HWGCR	heavy water moderated, gas cooled reactor

ICS	integrated control system
I&C	instrumentation and control
IGSCC	intergranular stress corrosion cracking
IPIS	intermediate pressure injection system
ISI	in-service inspection
LCO	limiting conditions for operation
LER	license event report
LPCI	low pressure coolant injection
LPCS	low pressure core spray
LSSF	loss of safety system function
MCP	main coolant pump
MFWP	main feedwater pump
MSIV	main steam isolation valve
MSSV	main steam safety valve
NDT	non-destructive testing
NSSS	nuclear steam supply system
OL	operating licence
OTSG	once through steam generator
PDP	positive displacement pump
PORV	pressure operated relief valve
RBMK	high-power channel-type reactor
RCIS	reactor core isolation system
RCP	reactor coolant pump
RCS	reactor coolant system
RFWP	reactor feedwater pump
RHR	residual heat removal
RPS	reactor protection system
RTB	reactor trip breaker
RTS	reactor trip signal
RWCU	reactor water clean-up
SBLC	standby liquid control
SDT	steam dump tank
SDV	steam discharge vent
SG	steam generator
SGPR	steam generator pressure relief
SIAS	safety injection actuation signal
SIT	safety injection tank
SJAE	steam jet air ejector
SRV	safety relief valve
SVCP	suction valve for charging pump
TS	technical specifications
WWER	water cooled water moderated power reactor

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