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01	Integration of technical and co-applicant review comments	28-11-2009
02	Consolidated Step 4 PCSR update: - Minor editorial changes - Update and addition of references - Section 2: o Errors of commission discussed in relation to the benefits of the SOA o Modifications to I&C architecture and the human machine interface incorporated - Section 3: o The role of the operator in case of severe accident added o Modifications to I&C in the case of Severe Accident integrated - Section 4 o Notification of an emergency to relevant organisations modified	31-03-2011
03	Consolidated PCSR update: - Addition of references (§2.0.2, §2.1.2, §3.1, §4.4) - References listed under each numbered section or sub-section heading numbered [Ref-1], [Ref-2], [Ref-3], etc - Minor editorial and typographical changes - Updates for consistency, including terminology, throughout text, and addition of cross-references to Sub chapter 18.1 (§2.1.1, §2.3, §2.4, §3.0.1, §3.1, §3.4.1). - New sub-section heading 2.1.1 “Main principles “ added and new sub-section 2.1.2 “Automatic Diagnosis (AD)” added with summary of AD	15-11-2012

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SUB-CHAPTER 18.3 – ABNORMAL OPERATION

1. INTRODUCTION

During both normal and emergency operation, the plant must be maintained in a safe state. To achieve this goal, three different plant operating categories are defined, depending on:

- the different operating and safety requirements to be achieved;
- the operating organisation and procedures necessary to operate the plant.

These three plant operating categories are defined as:

- normal operation (which includes operating manoeuvres that do not require the use of emergency operating procedures);
- emergency operation;
- severe accident management.

The operating category determines the applicable operating methods and documentation (operating procedures) as described in Sub-chapter 18.1 (Human Factors).

Normal operating procedures are described in Sub-chapter 18.2. This category covers situations from full power operation to those where the reactor is completely unloaded, including the starting up or shutting down of the plant.

Emergency operation, described in section 2 of the present sub-chapter, covers all the transients, incidents and accidents (PCC-2, PCC-3, PCC-4 and RRC-A conditions) addressed in the safety case. The Emergency Operating Procedures are based on a plant State Oriented Approach.

Severe accident management, described in section 3 of the present sub-chapter, corresponds to core melt scenarios and covers the RRC-B conditions addressed in the safety case.

The boundary between emergency operation and severe accident management is defined based on criteria related to “core exit temperature” or “containment dose rate” depending on the availability of core instrumentation. Exceeding these criteria implies that there has been a failure of emergency operation procedures to prevent core damage, requiring a change in operating documentation and organisation. Continuity is achieved between exiting emergency operation and entering into severe accident management.

Entry into severe accident management is irreversible (a return to emergency operation is not possible).

The principles that would be applied in developing an Emergency Plan for the UK EPR are described in section 4 of this sub-chapter. It is not possible at this stage of the design of the UK EPR to develop detailed emergency plans; nevertheless the principles of the arrangements can be established.

2. EMERGENCY OPERATING PROCEDURES FOR DESIGN BASIS TRANSIENTS, INCIDENT AND ACCIDENT CONDITIONS

The Emergency Operating Procedures (EOPs) for the EPR have been defined as far as they are able to influence the plant safety assessment (see accident analyses in Chapter 14 and Chapter 16). Emergency operating procedures address the way the plant is operated after transients, incidents and accidents, when operator actions are needed to restore the plant to a safe and stable state: this includes the transfer from hot shutdown to cold shutdown with the LHSI operating in RHR mode.

The emergency operating rules define post-accident mitigation from a process point of view (i.e. actions to be performed on the plant using information provided to the operator): their principles are described below. A discussion of plant operating procedures is provided in Sub-chapter 18.1, Human Factors.

2.0. SAFETY REQUIREMENTS

2.0.1. Scope

Emergency operating procedures cover the following transients, incidents and accidents, which are addressed by safety analysis:

- Plant Condition Categories (PCC) 2 to 4;
- Risk Reduction Category (RRC) A;
- Situations resulting from internal or external hazards, if necessary.

Emergency operation covers all initial states of the reactor, from state A to state F; its objective is to enable a *safe shutdown state* to be reached for PCC-2 to PCC-4 events, and the *final state* to be reached in for RRC-A sequences.

The boundaries of emergency operation are defined by entry and exit criteria.

2.0.2. Rules governing operating documentation

The operating documentation describing the actions to be performed (operating instructions) has not yet been developed for UK EPR. The development of these documents is the responsibility of the operating organisation and is therefore outside the scope of Generic Design Assessment (GDA). The detailed operating documents will be developed from upstream documents defining and justifying the operating strategy (operating rules).

The operating procedures comprise two main sets of documents: the “operating rules” and the “operating instructions”. The schedule for issuing these documents will be defined during site licensing.

The operating procedures describe the operations to be carried out to achieve a safe and stable state appropriate to the situation.

The input information used to develop these documents consists of the following:

- requirements and guidance documents (e.g. rules for the development of emergency procedures [Ref-1] [Ref-2]);
- documentation for elementary systems;
- analysis studies presented in the safety report;
- functional requirement studies;
- lists of qualified materials;
- thermal-hydraulic studies.

A final consistency check between the safety report studies and operating procedures will be performed during the detailed design phase, including requirements on equipment.

2.0.3. Rules applicable to operator actions

Emergency operation must enable the operator to perform the manual actions claimed in the safety analyses.

In the analyses of PCC-2 to PCC-4, it is assumed that the controlled state can be reached relying only on F1A systems (with the exception of some support systems as explained in Sub-chapter 3.2). It is further assumed that the transfer from the controlled state to the safe shutdown state can be achieved relying only on F1A systems and/or F1B systems. All the systems used to reach the safe shutdown state must be qualified for the conditions in which they are operated.

For RRC-A sequences, the final state may be reached using all systems, except those which are assumed unavailable due to the accident. In some cases, F2 systems are necessary to mitigate the accident so that the probability of core melt can be reduced to an acceptable level.

Moreover, emergency operation must allow the operator to perform the required manual actions within the limit period defined in the safety analyses (see Sub-chapter 14.0).

2.1. THE STATE ORIENTED APPROACH

2.1.1. Main principles

The aim of emergency operation is to restore the plant to safe and stable conditions, while ensuring the three fundamental safety objectives are achieved: reactivity control, removal of residual heat, and containment of radioactive material.

For the UK EPR, the emergency procedures are based on the State Oriented Approach (SOA). A discussion of Human Factors considerations in relation to the State Oriented Approach is provided in Sub-chapter 18.1.

The physical state of the plant can be characterised using a finite list of parameters. The State Oriented Approach arose from the observation that, even if there is an unlimited number of possible combinations of events or failures, these combinations of events or failures can lead to a limited number of plant physical states. The physical state is thus defined using a set of physical parameters that characterise the plant behaviour at a given time.

The physical parameters used have been grouped into six state functions defined for reactor closed states that can be assessed through instrumentation.

For the primary side, the state functions are:

- core sub-criticality, nuclear power range;
- RCP [RCS] water inventory;
- primary system residual heat removal;

For the secondary side, the state functions are:

- Steam Generator (SG) integrity;
- SG water inventory.

For the containment, the only state function is containment integrity.

The State Oriented Approach results in a limited set of strategies designed according to the physical state of the plant, irrespective of the sequence of events or failures that led to this state.

The set of emergency operating procedures covers all the plant operating conditions: at power, hot and cold shutdown, Safety Injection System operating in Residual Heat Removal system (RIS/RRA [SIS/RHRS]) connected or disconnected, primary circuit open (vent, vessel head, etc.). Depending upon the initial (pre-event) configuration of the primary circuit, and depending upon the severity of the event, the following sets of Emergency Operating Procedure (EOP) strategies have been developed:

- Primary circuit closed, 6 strategies covering operation following an incident:
  - power operation and plant shutdown;
  - stabilisation;
  - boration;
  - transition to cold shutdown;
  - station black-out operation;
  - total loss of cooling chain operation;
- Primary circuit closed, 8 strategies covering operation following an accident:
  - plant shutdown;
  - transition to cold shutdown, with safety injection;
  - transition to cold shutdown without safety injection;
  - transition to cold shutdown with steam generator tube rupture;
  - primary circuit water inventory restoration;

- stabilisation – nuclear power control;
- feed and bleed operation;
- high saturation margin reduction;

- Primary circuit open, 3 strategies:
  - stabilisation and make-up; RCP [RCS] pressurisable;
  - stabilisation and make-up; RCP [RCS] not pressurisable;
  - boration.

A specific strategy has been developed in order to manage accidents in the fuel pool irrespective of the plant operating conditions.

As an example, the following table displays overarching accident strategies and summarises the "state" operating conditions and SOA objectives of the 8 strategies covering operation following an accident (primary circuit initially closed).

"STATE" OPERATING CONDITIONS	**STRATEGY**	**OBJECTIVES**
Plant at power	Plant shutdown	Rapid load reduction until manual reactor trip at low power
Safety injection (SI) initiated, some state functions or boundaries degraded	Transition to cold shutdown with SI	Rapid transition to cold shutdown, to limit consequences
Some state functions or boundaries degraded	Transition to cold shutdown without SI	Rapid transition to cold shutdown, to limit consequences and avoid SI triggering
Degradation of SG primary to secondary integrity (including cumulated degradation of SG secondary integrity)	Transition to cold shutdown with steam generator tube rupture	Rapid leak cancelling and fallback to cold shutdown
Severe degradation of water inventory (overheating or level below bottom of hot leg)	Restoration of primary circuit water inventory	Recover water inventory by maximising water injection, cooldown, depressurisation
Degraded core subcriticality (abnormal neutron flux)	Stabilisation – Nuclear power control	Recover subcriticality margin by stabilising temperature and borating RCP [RCS]
Degradation of residual heat removal (not enough)	Feed and bleed operation	Establish heat removal by feed and bleed operation and fallback to cold shutdown

"STATE" OPERATING CONDITIONS	STRATEGY	OBJECTIVES
Degradation of residual heat removal (overcooling)	High saturation margin reduction	Avoid pressurised thermal shock and return to normal pressure/temperature operation

The State Oriented Approach is based on a self-adjusting process of permanent diagnosis of the state of the plant. In practice, an operator, when confronted with an accident situation, will develop a diagnosis of the state of the plant from a combination of the six state functions. This assessment will allow the operator to identify the required strategy, and to undertake the relevant actions. The evolution resulting from the diagnosis will lead to a re-evaluation of the state of the plant, and (if necessary) to a change of strategy.

The State Oriented Approach can be considered as a recovery mechanism in case of an error of commission:

- by looping within the required strategy, the operator is likely to see an error that he has made previously,
- due to the continuous diagnosis of the state of the plant, the required strategy is able to change in the case of degradation of the plant state due to an error of commission.

SOA operating experience feedback has been documented for the EDF Nuclear Power Plant (NPP) fleet [Ref-1] [Ref-2]. This is discussed further in Sub-chapter 18.1.

2.1.2. Automatic Diagnosis (AD)

The Automatic Diagnosis system is an integral part of the overall alarm system. It also supports effective implementation of the SOA during emergency operation. The AD system continuously monitors plant status using a range of parameters. This monitoring process incorporates the use of redundant data (measurements, system states, valve positions etc) to ensure that the AD system is robust with respect to loss of data (from sensors, limit switches etc) that are used to generate parameters. The Automatic Diagnosis system Human-Machine Interface (HMI) is provided via the MCP [PICS] and, when necessary, indicates to the operating team the emergency operating strategy which is most appropriate for the current state of the plant.

The main objectives of the Automatic Diagnosis system [Ref-1] are;

1. To reliably diagnose the state relating to the Nuclear Steam Supply System (NSSS), leading the operating team to the appropriate strategy to apply.
2. To relieve the operator of orientation and reorientation activities and, as a consequence, reduce workload and stress.

Arguments and evidence to support the claim that the AD system reduces the potential for misdiagnosis are provided in Sub-chapter 18.1, including consideration of AD failure.

The type of indication provided by the system to the operator varies depending on whether the Reactor Coolant System (RCP [RCS]) is open or closed.

With the RCP [RCS] closed, in accident conditions, the purpose of the AD system is to provide the operator with an initial orientation leading to an appropriate strategy for dealing with the state of the plant. The system re-orientates if the plant's state changes. Any subsequent reorientation is accompanied by a distinct and compelling audible alarm. If not in accident conditions then the AD system will prompt the operator to apply the initial orientation in incident conditions. The system is designed so that if a combined incident and accident condition event occurs, then the AD system will indicate the appropriate accident strategy.

With the RCP [RCS] open, there is no distinction made between incident and accident conditions [Ref-2]. The AD therefore indicates the relevant strategy in this state.

When the criteria for incident or accident conditions are met, the AD system becomes active. This is indicated to the operator by the AD icon, present in every MCP [PICS] format header, which illuminates red and flashes, and is accompanied by a clear auditory signal specific to AD activation. A discussion of the AD annunciation function is provided in Sub-chapter 18.1.

The Automatic Diagnosis status display is available on all MCP [PICS] workstations in the Main Control Room but is not automatically displayed. The operator selects the screen via the AD header at the top of the MCP [PICS] screens.

The AD status display fits on a single page and includes the title of the strategy to be applied, its objective, and plant parameters representative of the state functions [Ref-2]. Counters are also displayed which indicate the time elapsed since signals initiating safeguard or protection systems (such as reactor trip or safety injection) have been actuated.

There are two different AD status displays depending on whether the RCP [RCS] is in a non-closed or closed state. For consistency, all data of a particular type is displayed in the same position for each display. For non-closed RCP [RCS] states, the main plant parameters are displayed [Ref-2] and for closed RCP [RCS] states, the six state functions and their respective degradation status is displayed on the left side of the display screen. The three functions associated with the primary side; core sub-criticality, RCP [RCS] water inventory, and primary side heat removal, are at the top of the display. The secondary side functions; steam generator integrity and water inventory, are displayed in the middle, and the containment integrity is located at the bottom of the display.

Operators are able to view, on a separate page, a self-contained breakdown of the logic diagram which shows all possible paths and parameters used to determine the automatic diagnosis result. The path leading to the diagnostic result is highlighted so that the operator is able to visually trace the logic behind the decision and understand the result of the AD. This will therefore contribute to the operator's situational awareness.

Based on the diagnosis provided, the Operator Action (OA) selects and implements the appropriate 'action procedure'. The Operator Strategy (OS) selects and implements the corresponding 'strategy procedure'. The roles and responsibilities of the OA and OS are defined in Sub-chapter 18.1.

2.2. SCOPE OF EMERGENCY OPERATION

Emergency operation may be required in any reactor initial state, from at-power to a completely unloaded core state; it covers:

- all the events addressed in safety analyses (PCC-3 to PCC-4 events and RRC-A sequences);

- PCC-2 initiating events that require the application of strategies that are outside the scope of normal operation (note that certain PCC-2 events are covered by procedures for normal operation).

Emergency operation in accident conditions (PCC-4, RCC-A) potentially involves some degradation in the physical state of the plant. Therefore development of strategies for Emergency Operating in accidents requires analysis of the physical state of the plant, and application of pre-defined response strategies. Emergency operation covers a potentially unlimited set of situations, in a more or less optimised way depending on the complexity of the situation.

Emergency operation in transient and incident conditions (PCC-2 and PCC-3 events) covers situations that do not lead to a degradation of the physical state of the plant, but where an operating strategy is required that is outside the scope of operating strategies for normal operation.

Emergency operation covers operation following events in the Fuel Pool Cooling System.

Finally, in accordance with safety requirements, emergency operation addresses the potential functional consequences of both internal and external hazards. The hazard assumptions and design dispositions are described in Chapter 13.

Mitigation against hazards relies essentially on design arrangements (e.g. arrangement of equipment within the civil structures, seismic classification), and is supported where appropriate by operator actions such as:

- if functional analyses of the consequences of the occurrence of an internal hazard require specific operating actions, these actions will be included in the appropriate operating procedure document. The necessary actions to confirm that automatic actions have been correctly carried out (e.g. fire zoning) would be included in this document;
- in order to deal with external hazards, pre-planned measures may be applied depending on how relevant they are to the plant (e.g. warnings before alerts, specific operating instructions, specific actions required from technical support teams in case of total loss of heat sink or LOOP or as a long-term consequence of an external hazard such as flooding).

Emergency operation is continued until the safe state is reached. The safe state concept covers, but is not limited to, the safe shutdown state as defined for PCC-2 to PCC-4 and the final state as defined for RRC-A. This safe state may be different from the safe shutdown state. The safe state is specified on a case-by-case basis and characterised by the range of the relevant parameters.

Emergency operation is optimised for events most likely to occur (realistic operation). Emergency operation should minimise the consequences of any accident, while complying with the safety studies.

2.3. ENTRY AND EXIT CRITERIA

The list of criteria requiring entry into emergency operation is as follows:

- reactor trip, or safety injection signal;

- severity 4-labelled alarm related to systems/equipment;
- an explicit request within normal operating procedures (such as non severity 4-labelled alarm sheets, Operating Technical Specifications, normal operating instructions).

Exit from emergency operation is possible, if either of the two following conditions is fulfilled:

- emergency operation has been successful, i.e. it has brought the plant to a safe and steady state. It is possible to exit from emergency operation if the exit conditions listed in the emergency procedure are fulfilled;
- emergency operation has failed, characterised by core outlet temperature indicative of core melt conditions. In this case, emergency operating procedures would require a transition to severe accident management.

The transition modes, in case of exit from emergency operation, can be characterised by the following three scenarios:

- <u>Transition to normal operation</u>
  Emergency operation has been successful. The plant state is compliant with all safety requirements. It is possible to use normal operating procedures to re-start the plant and reconnect it to the grid.
  In this case, exit from emergency operation leads to entry into a specific transition mode, which does not last for a long period. In the transition mode, the operational objectives are: to continue monitoring the plant, and to re-configure the systems in normal operation mode. After the transition period, the plant will be in normal operation: the Operating Technical Specification can thus be applied without restriction.
- <u>Transition to repair state</u>
  Emergency operation has been successful, but the state of the plant is not compatible with normal operating requirements. It is necessary to enter a repair state in order to repair the plant. In this case, the operating shift team and the Plant Director will liaise with the necessary technical support teams to identify the repair state required, the way to reach it, and the necessary parameters to be monitored during the transition. When the repair is completed, the previous scenario applies (transition to normal operation).
- <u>Transition to Severe Accident Management</u>
  The transition to Severe Accident Management is necessary when Severe Accident entry criteria are fulfilled. The severe accident entry criteria are monitored during emergency operation. In this case, severe accident procedures are used instead of emergency procedures. The decision to use severe accident procedures instead of emergency procedures is taken by a duly authorised person. This is explained in more detail in Sub-chapter 18.1.

2.4. DESCRIPTION OF EMERGENCY OPERATION

The emergency operating rules describe the operations required to reach the most appropriate safe state for the plant conditions.

Two initial plant ranges are distinguished:

- reactor primary system closed, LHSI in RHR mode connected or not;
- reactor primary system open.

For each range, emergency operation involves several different operating strategies depending on the state degradation level. When the reactor primary system is closed, a prescribed diagnosis of the six state functions by the Automatic Diagnosis system is used to assess the plant status and define the operating strategy most suitable for the plant status. When the reactor primary system is open, a prescribed diagnosis of relevant information is used to assess the plant status and define the operating strategy most suitable for the plant status. Manual diagnosis is also possible on the MCP [PICS] in the case of AD failure.

When the reactor is closed, the prescribed diagnosis is based on the following F1B information:

State function	Information used
Core subcriticality – Nuclear Power Range	Neutron flux measurement
RCP [RCS] water inventory	Core outlet saturation margin or Reactor Vessel Water Level Measurement
Primary system residual heat removal	Primary pressure and Core outlet temperature or Core outlet saturation margin
SG integrity	Secondary pressure (per SG) and Secondary activity (per SG)
SG water inventory	SG water level
Containment integrity	Containment pressure and Containment activity

The operator uses available operational systems (including F2 systems) and/or F1A and F1B safety systems.

A non-exhaustive list is provided below:

Actions	Operational systems	F1 safety systems
RCP [RCS] cooldown	Main Steam Bypass GCT [MSB]	Main Steam Relief Train VDA [MSRT]
SG feeding	Main Feedwater System ARE [MFW], Startup and Shutdown System AAD [SSS]	Emergency Feedwater System ASG [EFWS]
RCP [RCS] feeding	Chemical Volume Control System RCV [CVCS]	Medium Head Safety Injection (MHSI), Low Head Safety Injection (LHSI),

Actions	Operational systems	F1 safety systems
		SI Accumulators
RCP [RCS] boration	RCV [CVCS]	Extra Boration System RBS [EBS], MHSI, LHSI
RCP [RCS] depressurisation	Normal spray RCV [CVCS] auxiliary spray	Pressuriser Safety Valve (PSV)

Emergency operation is carried out using the computerised Human-Machine Interface which comprises the class 1 Protection System Operator Terminal (PSOT) that provides the interface to the Protection System and the class 3 display and control system (Process Information and Control System (MCP [PICS]). However, in the event of unavailability of the computerised Human-Machine Interface, emergency operation, including manual diagnosis, can be performed using the class 1 conventional HMI, the MCS [SICS], within which means of control and information required for emergency operation are implemented (see Sub-chapters 7.3 and 7.5).

In the event of detection of total loss of computerised I&C (TLIC), protection and controls are performed through a non-computerised safety system (NCSS) and specific NCSS procedures are applied.

Operator actions claimed in relation to the scenarios outlined above are discussed in Sub-chapter 18.1.

2.5. LINKS BETWEEN OPERATION AND EQUIPMENT QUALIFICATION

The classified equipment and system functions that must be qualified for emergency ambient conditions must be listed as a necessary input for the development of the emergency operating rules and instructions.

The development of these lists is based on:

- functional requirements analyses, based on the accident analyses described in Chapter 14 and Chapter 16;
- analysis of emergency operating requirements: data necessary to characterise the plant state and to identify the relevant operating procedure.

The process for developing the qualification requirements for the classified equipment required for emergency operating conditions is as follows. Firstly, a preliminary set of process data is prepared taking into consideration the process data available in the EPR plant. This set of data is consolidated as the development of the emergency procedures progresses.

The design process of the emergency operating procedures involves analysis based on the following rules:

- it is ensured that failure of any single item of process data (i.e. where the process data delivers inappropriate information) could not lead to an unacceptable deterioration of the emergency situation (robustness-like analysis);

- it is ensured that the equipment is used in accordance with its qualification requirements (mission time and ambient conditions in terms of pressure, temperature, and humidity possibly combined with radiation), and that the failure of any piece of equipment that might be used beyond its qualification limits could not lead to an unacceptable deterioration of the emergency situation;

- emergency procedures are amended or, if necessary, equipment design is changed (including qualification requirements), if the two former conditions cannot be satisfied.

The final step is a final verification of the consistency between the emergency procedures and the situations that they must cover.

3. OPERATING PRINCIPLES FOR SEVERE ACCIDENT CONDITIONS

3.0. SAFETY REQUIREMENTS

3.0.1. Scope

Operating principles for severe accident conditions must cover at least the RRC-B scenarios considered in the safety analysis. These scenarios, which are analysed using realistic assumptions, cover in particular the phenomena addressed in the design of systems dedicated to severe accidents.

For each phenomenon studied (for example core melt under high pressure and direct containment heating), specific safety criteria are defined and used to verify the design (see Sub-chapter 16.2).

3.0.2. Rules

The systems required to meet the above criteria must be at least F2-classified. They must also be qualified for severe accident conditions.

In contrast to PCC/RRC-A studies, a target controlled state/final state is not defined for severe accidents. However, the general objective of severe accident operating principles is to reach controlled and stabilised conditions.

3.0.3. Regulatory framework

Technical Guidelines for the design and construction of the next generation of pressurised water nuclear reactors (see Sub-chapter 3.1 - Table 1 E 2.3.3) require that relevant information is provided to the operators and emergency response teams in severe accident situations.

3.1. FIELD TO BE COVERED

The main areas of concern associated with severe accidents are:

- primary system depressurisation;
- hydrogen control;
- basemat protection;
- decay heat removal from containment;
- containment pressure control;
- limitation of radioactivity releases.

Dedicated systems have been designed to address these concerns, which must be actuated when a severe accident occurs, either manually or passively. For the plant to operate in these conditions, the following must be ensured:

- the actions must be successfully initiated by the operator;
- the efficiency of the mitigation process must be monitored;
- the general plant state and environmental releases must be monitored.

During severe accident progression, the operators monitor specific parameters in order to perform the relevant actions recommended in the severe accident management documentation, either systematically or, later in the accident sequence upon technical support recommendation. A discussion of the HMI used in severe accident scenarios, MCR team roles and responsibilities, procedures and claims on operator action is provided in Sub-chapter 18.1.

A description of the instrumentation provided for severe accident management is presented in Sub-chapter 7.6.

In the case of a severe accident and total failure of the computerised I&C, the Non-Computerised Safety System (NCSS) supports the necessary manual actions (primary depressurisation, containment isolation, EVU [CHRS] actuation) for the mitigation of the accident ([Ref-1] [Ref-2]).

3.2. LINKS BETWEEN OPERATION AND EQUIPMENT QUALIFICATION

The equipment required for severe accident mitigation is qualified for the conditions and the necessary mission time.

The required instrumentation can be divided into two main categories:

- the first category involves instrumentation needed for the operator to perform the required actions. Satisfactory performance and survivability is needed for all instrumentation in this category (sensors, transducers, etc.) in the expected severe accident conditions. Qualification for the severe accident conditions is required for instrumentation in this category (see Sub-chapter 3.6);
- the second category involves other instrumentation that could be useful for monitoring the progress of the accident and predicting the environmental consequences. Most of the information that would be useful in managing severe accidents would be available from instrumentation designed for use in PCC events and qualified for such events. However, the capabilities of this instrumentation to operate in severe accident conditions (pressure, temperature and irradiation) must be confirmed and recorded in the Severe Accident Management Guidelines.

3.3. DOCUMENTATION AND CRITERIA FOR DECLARING A SEVERE ACCIDENT CONDITION

Whereas emergency operating procedures focus on safeguarding core integrity, priorities for severe accidents are directed towards limiting radioactivity releases into the environment and preserving containment integrity: this involves implementation of certain dedicated systems and mitigation strategies. For such highly improbable conditions, the operation of the unit may also require unusual operational actions, which might be contrary to the principles of operation in normal or emergency conditions. Consequently, it is necessary to understand the differences between procedures and guidelines applied in these two operating states. Dedicated documentation is therefore applied to severe accident management.

The criterion chosen for switching from emergency operation to severe accident operation is a core outlet temperature greater than 650°C.

In some shutdown states when core outlet temperature measurements are unavailable, containment dose rates will be used to define the criterion for entry into severe accident operation.

3.4. OPERATING PRINCIPLES

Operating principles for severe accidents [Ref-1] deal with issues presented in Sub-chapter 3.1, as detailed below.

3.4.1. Primary system depressurisation

A core outlet temperature of 650°C is used as the primary depressurisation criterion, at the start of severe accident operation. The core outlet temperature is monitored by the Safety Engineer (see Sub-chapter 18.1). Emergency operating procedures already specify actions to depressurise the primary system in case of coolant inventory degradation (fast cooldown of the SGs, opening of pressuriser relief valves). The opening of the pressuriser discharge line provisionally allocated to severe accidents reduces the risk of vessel rupture at high pressure, and hence the risk of containment failure via direct containment heating.

The depressurisation process can be monitored by position indications on relief valves provisionally allocated for use in severe accidents.

3.4.2. Hydrogen control

The objectives of controlling the risk due to hydrogen (see Sub-chapter 6.2) are achieved via use of catalytic recombiners.

These systems are purely passive and do not require manual actuation.

Homogenisation of containment atmosphere is achieved before the occurrence of severe accident conditions by the opening of passive devices (foils and mixing dampers) which allow the containment to transition from two-room to one-room convection.

3.4.3. Basemat protection

The corium retention concept (see Sub-chapter 6.2) requires no operator action as corium flooding is passively triggered after the corium has spread.

A check may however be made to ensure that the corium has been successfully transferred to the spreading chamber by detection of the vessel rupture followed by a temperature increase measured by thermocouples located in the chimney above the spreading area. The position of the passive flooding valves provides an indication which confirms that the corium is covered with water.

A check can be made that the corium has been successfully retained (including its cooling) by monitoring the containment pressure and the power extracted by the EVU [CHRS]. Failure to cool the corium and loss of integrity of the core catcher would be detected by temperature measurements at the entrance to the main collector cooling channel.

3.4.4. Decay heat removal from the containment

Manual actuation of the system for decay heat removal from the containment (EVU [CHRS]) (see Sub-chapter 6.2) is required to limit both the containment pressure (to below the containment design pressure) and the radiological source term. The EVU [CHRS] is initiated in spray mode before the containment pressure limit is exceeded.

Operation of the decay heat removal system may be monitored using measurements of temperature and flow rate in the EVU [CHRS] and its dedicated cooling system. The activity level and the sump water level in the EVU [CHRS] rooms located in the Safeguard Auxiliary Buildings provide an additional means for detecting an EVU [CHRS] leakage and for accessibility assessment for these compartments.

3.4.5. Containment pressure control

As with decay heat removal, the containment over-pressure is mitigated by the EVU [CHRS]. Manual activation of the EVU [CHRS] ensures that the containment pressure remains below the containment design pressure.

3.4.6. Limitation of radioactivity releases

Limitation of releases to the environment is ensured by actuation and operation of the systems described above, and by ensuring all potential leakage paths to the environment are isolated if feasible. Isolation of all the lines penetrating the containment walls, and evacuation of personnel from the reactor building and its isolation must also be checked. This checking is normally carried out during the first phase of the accident, before severe accident conditions have developed (see Sub-chapter 6.2). Containment penetrations not isolated in the framework of accident management and not used during severe accident must be isolated.

In addition, operation of the systems providing ventilation and filtration of the inter-containment annulus (see Sub-chapter 6.2), and the safeguard and fuel building must be confirmed.

Releases may be monitored by means of dose rate indications inside the containment, the containment annulus and via activity in the stack.

4. EMERGENCY PREPAREDNESS

4.1. INTRODUCTION AND REGULATORY FRAMEWORK

For Nuclear Power stations operating in the UK it is a condition of the site licence, and a requirement of the Radiation Emergency Preparedness and Public Information Regulations 2001 (REPPIR) [Ref-1], that the licensee must have emergency plans in place for any 'reasonably foreseeable' radiation emergency. The primary aim of these plans is to restrict exposure to ionising radiation in the event of an emergency and to ensure the health and safety of all persons present on site and in the surrounding area. It is the licensee's responsibility to assess radiation emergencies which are reasonably foreseeable. A reference scenario must be put in place to encompass accidents that are thought to be reasonably foreseeable and these accidents must be prepared for in detail. Emergencies that are not reasonably foreseeable and go beyond the reference scenario are dealt with through the concept of extendibility, and the plans must have the flexibility to allow for this.

It is not possible at this stage of the design of the UK EPR to develop the emergency plans to the level of detail that will eventually be required before commissioning of the plant. Emergency plans, site organisation and procedures will be defined during the detailed design phase to cover postulated emergencies. Nevertheless, the principles of the arrangements can be established at this time. The purpose of this sub-chapter is to present the principles that would be applied in developing an Emergency Plan for the UK EPR.

4.2. GENERAL REQUIREMENTS

The Emergency Plans would be written in compliance with the requirements of WENRA reference level issue R and Health and Safety Executive (HSE) Safety Assessment Principle (SAP) Fundamental Principle: FP 7 and Accident Management and Emergency Preparedness Principle: AM.1.

The Emergency Plans would be regularly reviewed, tested and updated and all employees would be given appropriate training to ensure that the plans can be implemented efficiently and effectively.

In addition to the on-site plans prepared by the licensee, off-site plans would be prepared by the local authority in consultation with the licensee and other relevant agencies. In the event of an off-site nuclear emergency, the off-site response would be co-ordinated by the police and would deal with the welfare of the population in the vicinity of the site. The licensee would provide all information to the local authority that would be required to prepare the off-site emergency plan. The local authority would ensure that the site and its risks were reflected in the Community Risk Register. The off-site emergency plan would mainly focus on the detailed emergency planning zone as defined by HSE.

A Strategic Co-ordinating Centre, (SCC), would be established in close proximity to the site, most probably at the local police headquarters with a media briefing centre nearby. A Strategic Coordinating Group, under chairmanship of the police, would co-ordinate the off-site emergency response and make decisions on the best course of action to protect the public. Information and advice would be passed on to the public via the media.

In addition to the SCC, it is possible that a Central Emergency Support Centre, (CESC) would be established within the licensee organisation to provide corporate engineering support.

Central Government would co-ordinate the response at the national and international level, briefing parliament, media and international partners. Central Government may also be required to supply specialist advice and assistance to support the local response. A Government Technical Adviser (GTA) would be appointed to attend the SCC, to provide independent and authoritative advice and the government position, at media briefings.

4.3. MAIN OBJECTIVES OF EMERGENCY ARRANGEMENTS

As noted above, emergency preparedness is essential for any site on which work with ionising radiation takes place. Once a hazard / risk assessment has taken place, appropriate Emergency Plans would be established for prevention and mitigation of any adverse consequences of an event on site.

In order to meet the objective of prevention and mitigation, Emergency Plans would include clear arrangements for gaining control of the emergency and returning the site to a safe state. Clear roles and responsibilities for those working on site would be established as well as procedures for warning, notification, and communication between those involved in the emergency response. In addition, a description of specialist equipment and resources that are available would be included.

It is vital that timely information and advice is communicated to the local authority and the public, to ensure that the correct action is undertaken to carry out the appropriate countermeasures efficiently and effectively. Mechanisms would be put in place to enable smooth communication to take place.

The licensee would establish:

- arrangements for monitoring of radiation in and around the site and providing information and expert advice to the SCC;
- medical arrangements for monitoring the dose to all persons involved in the on-site emergency response and providing medical surveillance of those affected;
- emergency exposure limits and a list of employees authorised to receive exposure to these doses;
- access to personal protective equipment and other tools required to minimise radiation exposure.

The plans would also include arrangement principles for dealing with accidents larger than the reference scenario but these would not have the same level of detail as for the reasonably foreseeable emergency. Consideration would be given to the potential need for additional resources and for liaising with additional local authorities and agencies.

In order for the plans to work effectively, regular testing and reviews would take place and all employees would have appropriate training to ensure that they were able to perform their duties in an emergency situation. There would be co-ordination with the local authority to ensure that the off-site plan worked smoothly alongside the on-site plan.

In summary, the licensee plans would include processes to:

- commence the notification chain to alert all emergency responders;
- bring the off-site nuclear emergency under control and bring the site to a safe condition;

- reduce risk to all emergency responders and limit radiation doses;
- limit exposure of the public by initiating the necessary countermeasures;
- ensure all relevant organisations/agencies are closely linked and working to accurate information;
- ensure that the Government, media and general public are effectively and accurately informed at all times with direct information from the licensee;
- enable an extended response;
- test, review and update the plans;
- train all staff in performing their duties as specified in the plans.

4.4. DEFINITIONS OF EMERGENCY AND RELEVANT SITUATIONS

A radiation emergency is defined in the Radiation Emergency Preparedness and Public Information Regulations (REPPIR) [Ref-1] as any event likely to result in any member of the public being exposed to ionising radiation arising from that event in excess of any doses set out in Schedule 1. Schedule 1 specifies the following doses;

1. An effective dose of 5 mSv in the period of one year immediately following the radiation emergency.

2. Without prejudice to paragraph 1 -

(a) an equivalent dose for the lens of the eye of 15 mSv in the period of one year immediately following the radiation emergency; and

(b) an equivalent dose for the skin of 50 mSv in the period of one year immediately following the radiation emergency over 1cm^2 area of skin, regardless of the area exposed.

These limits would be translated into a set of predetermined plant conditions that if met would immediately lead to an emergency being declared.

4.5. RESPONSE

Responsibility for emergency scheme preparedness would be allocated to a specific role within the station organisation, termed the Emergency Preparedness Engineer (EPE) for the purposes of the current PCSR. The person undertaking this role would ensure that the arrangements met all the requirements of the REPPIR regulations and could be carried out to deliver a rapid and efficient response to handle any emergency that might occur on the site. The EPE would be responsible for communicating with the local authority for preparing the off-site plan and for ensuring that the off-site plan interfaced with the on-site plan.

The arrangements would cover the following areas:

- declaration and cancellation of an emergency;
- warning and communication systems on site;

- notification of the local authority and all other organisations involved in the emergency response;
- site emergency organisation to manage and configure site to a safe condition and terminate radiation release;
- liaison with external emergency services responding on site;
- formulation of strategies to inform and protect the public before set up of SCC;
- personal dose assessments;
- authorisation of emergency exposure dose limits;
- monitoring radioactive release levels on-site and in a defined surrounding area;
- media handling;
- collaboration with SCC and Government Technical Advisor (GTA);
- recovery.

4.5.1. Declaration and cancellation of an emergency

According to a pre-arranged set of criteria regarding the state of the plant, a state of either an on-site incident or off-site emergency would be declared by a nominated authorised employee, designated as the “Emergency Controller” (EC) or equivalent. The state of the plant is continuously monitored in the main control room and there are alarm systems to notify the control room shift team if there is an abnormal situation. As part of the monitoring procedures, if necessary an incident or emergency would be declared and emergency plans initiated. The team structure will be such that an authorised Emergency Controller would be available at all times within 1 hour at the station and be able to communicate directly with the station to declare the incident or emergency and initiate the plan.

An emergency might be declared as a precautionary measure to ensure that the emergency response teams were ready to act and so that detailed diagnosis and prognosis could be made regarding the state of the plant. In the majority of cases the situation would be likely to be brought under control without the need for emergency actions, allowing the state of emergency to be cancelled.

Depending on the emergency state reached, the procedure for cancellation could be different:

- if emergency actions had not yet been taken, the Emergency Controller could cancel the declaration;
- if the full emergency plans had been set in motion, and a GTA appointed, then it would be the responsibility of the GTA to cancel the off-site declaration having consulted the Emergency Controller who would remain in charge of cancelling the on-site declaration. If the GTA had not yet been appointed then the Emergency Controller would be able to cancel the declaration in consultation with the SCC and CESC (if used).

4.5.2. Warning and communication systems on site

In the event of an incident or emergency being declared there would be alarms accompanied by announcements on the site-wide loud speaker system, instructing staff on actions to take and providing additional information. Instructions would include a summons to roll-calls at pre-defined muster points. The meanings of the alarms and announcements would be standardised and transmitted to the staff during training. Information notices would also have been placed around the site to inform employees of the actions that should be taken when the specific alarms are heard.

The alarms would be both audible and visual for those areas in which there is a noisy environment, and would be transmissible to the entire site, or just to the locality of the event. The alarms would be connected to self-monitoring systems to detect failures and would be able to be activated manually from the main control room, the remote shutdown station, or from the security and emergency control centre. Emergency Organisation personnel could also be notified with a pager/ telephonic communication system that could be received over the whole site. The loud speaker and paging systems would be controlled primarily from the main control room and would have a back-up power supply.

Two telephone systems would be provided to deliver telephone links between all sensitive plant zones, one of which was linked to the public telephone exchange. On duty staff could thus be contacted through two independent routes from the main control room and would be able to be operational within one hour of an emergency plan being triggered. Radiological monitoring teams would also be able to be contacted through a robust communication system.

4.5.3. Notification of the local authority and all other organisations involved in the emergency response

In order to ensure immediate notification of the appropriate external organisations once an emergency had been declared, relevant organisations would be contacted via a protected telephone link to ensure that communication between those involved in both the internal and external emergency response was immediate. A notification chain would be agreed with the local authority and police to ensure that all organisations in the wider response were promptly contacted.

There would also be a telephone network link to the National Grid.

4.5.4. Site emergency organisation to manage and configure site to a safe condition and terminate radiation release

A duly authorised person based in the main control room would be in charge of initial event diagnosis and would therefore choose the correct operating procedure and organise and control all licensee actions. The Duty Emergency Controller would make the initial declaration of the incident or emergency and would initiate the emergency plan with any on duty staff.

4.5.5. Liaison with external emergency response teams working on site

External emergency teams who would be required as part of the on-site response would be required to familiarise themselves with the site and meet the on-site employees and take part in exercises as required. They would also be involved in the specialist training and exercises provided for on-site employees. There would be a designated reception area to brief and equip the teams in the event of an accident, and procedures would be put in place to ensure swift notification and action.

4.5.6. Formulation of strategies to inform and protect the public before set up of SCC

Before the Government Technical Advisor is available, the licensee's technical advisors would provide advice to the police and local authority on the action to be taken to protect the public.

The main three countermeasures that can be used to protect the public are sheltering, evacuation and distribution of potassium iodate tablets. The dose levels that should be taken as limits when considering these countermeasures will be based on the Health Protection Agency (HPA) recommended Emergency Reference Levels. These are provided in the form of upper and lower limits. Above the upper limit, it would always be worthwhile to implement the countermeasure and below the lower limit it would not be necessary. Between the upper and lower limits it is desirable to implement countermeasures if practicable to do so.

When considering what strategy should be implemented, the principles and purposes of intervention found in REPPIR Schedule 8 would be adhered to.

4.5.7. Personal dose assessments

Dose limits to workers in normal operation must not exceed the statutory limits as stated in the Ionising Radiation Regulations 1999, IRR, schedule 4 [Ref-1].

IRR 1999 Annual equivalent dose limits for employees aged 18 years and over;

- whole body – 20 mSv;
- hands, forearms, feet, arms, skin – 500 mSv;
- lens of eye – 150 mSv.

The annual whole body equivalent dose to workers during normal operation for UK EPR would also comply with the more stringent SAP target of 10 mSv (see Sub-chapter 12.0).

Employees or external teams involved in the emergency response would be issued with suitable dosimeters from an approved dosimetry service. Some of these employees would have been provided with routine dosimetry but might also be provided with additional dosimeters in the event of an emergency if this was felt necessary. As stated in IRR regulation 23, all persons likely to receive a dose in excess of 6mSv or an equivalent dose greater than three tenths of any relevant dose limit would be required to have a dose assessment. For those employees likely to receive emergency dose levels, additional arrangements would be put in place.

4.5.8. Authorisation of emergency exposure dose limits

Preparations would be made for those situations where employees might be exposed to doses greater than the limits specified in IRR schedule 4. Employees would only be permitted to receive such higher doses if it was absolutely necessary to help those in danger, or to prevent exposure of a large number of people. In extreme situations, the emergency dose limits can be exceeded in order to save a life. The definition of emergency dose only refers to exposure during the emergency response and not that due to the emergency itself. However, it is important to consider the doses received during an emergency when ensuring that the total dose is in line with agreed limits.

Only specifically designated employees (usually Emergency Controllers) would be able to authorise employees to receive emergency doses and they would be given appropriate training to enable them to perform this task. They would be expected to assess the level of fitness and training of the employees, and to manage their exposure in the event of an emergency. They would also be required to take account of doses received in the accident when giving authorisation to others to receive emergency doses during the emergency response. They would be required to confirm that the doses received in the accident did not approach the dose levels for emergency exposures and were as low as reasonably practicable (ALARP). Those employees who were approved to receive emergency doses would be identified in advance and would have given prior agreement that they were willing to receive the doses in emergency situations. Specialist radiation protection advice and instruction would be given to all such employees.

The emergency dose limits would be agreed with the HSE in advance, after full assessments had taken place to consider the possible doses that employees might be exposed to in an emergency. It is expected that these doses would not exceed the doses regarded as acceptable within UK regulations i.e.

- effective dose – 100 mSv;
- equivalent dose to skin - 1000 mSv;
- equivalent dose to eye lens – 300 mSv;
- in the case of life saving actions, a whole body dose limit of 500 mSv should be applied and a dose of 5000 mSv to the skin.

Emergency doses must be measured separately from routine doses received by the employee and additional dosimeters would be issued at the time of the emergency. An approved dosimetry service would be used to assess the doses received by employees and HSE, the employer and a medical advisor would be notified of the results immediately. Medical surveillance would be arranged for all employees who receive emergency exposures. Any individual who received an effective dose in excess of 100 mSv in a year, or a dose at least twice the relevant dose limit in IRR, or if the medical advisor felt it was necessary, would undergo a special medical examination. Health records resulting from medical surveillance would be kept for at least 50 years.

Specialist equipment would be provided to minimise exposure to radiation. This could include remote handling tools, personal protective equipment such as air fed suits and potassium iodate tablets (under medical surveillance). Similar equipment would also be provided to the external agencies who formed part of the on site emergency response.

4.5.9. Monitoring radioactive release levels on-site and in a defined surrounding area

Monitoring is a key element in the prevention of radioactive releases and is a key input for decision making regarding the actions to be taken in an incident or emergency. There are many agencies with monitoring responsibilities and the Health Protection Agency would co-ordinate work and resources.

Continuous monitoring would take place on site, of rooms, staff and plant effluents. In the event of an emergency, the licensee would be responsible for monitoring an extended area around the site, to be agreed when finalising the off and on site emergency plans. The bodily contamination and dosimetry control and irradiation of rooms system (KRC) uses fixed and portable measuring devices to monitor rooms and staff to ensure that dose rates are in line with predicted levels and to prevent contamination spreading outside controlled zones. The Plant Radiation Monitoring System (KRT [PRMS]) ensures containment integrity on the unit and can initiate actions to control activity levels if necessary. This system can be used as a diagnostic tool to establish the source of an elevated dose level. In addition to containment barrier surveys, the system monitors all site effluents to ensure any release is within acceptable levels. All the measurement data is captured in the main control room and is registered and archived.

Processes would be put in place to ensure that all monitoring results are communicated with the necessary organisations and that the technology is in place to allow the data to be shared efficiently.

Monitoring would continue into the recovery phase of an emergency, to ensure the safety of the public in the local environment, and to confirm that the site is in a safe condition.

4.5.10. Media handling

It is recognised that in the event of an emergency, the demand for information by the public would be very substantial and therefore clear arrangements would be put in place to deal with the media. The media would also play a vital role in giving out advice to the public in the local vicinity concerning actions that should be taken. Therefore preparations would be made to ensure that advice and information was given out promptly, clearly and accurately. The arrangements for the Media Briefing Centre (which would be likely to be adjacent to the SCC) would be covered in the off-site emergency plans. However it would be important for the licensee personnel to be represented and for the media to be provided with the correct information about the status of the emergency.

It is likely that a senior employee would be appointed as the Media Technical Briefer (MTB) and he or she would be supported by a Senior Press Officer and a Media Briefing Centre Press Officer. The MTB would present technical information to the media including information about the licensee's response and the plant prognosis. They would also provide background information on the company and on technical issues. The press officers would give Public Relations (PR) advice to the MTB and liaise with other organisations involved in the emergency response regarding press conferences and media briefings.

4.5.11. Collaboration with SCC and Government Technical Advisor (GTA)

Effective communication systems would be established between the SCC and the licensee. Representatives would attend the SCC to give expert advice and ensure that information is provided accurately and efficiently. Before the arrival of the GTA, a licensee's technical advisor would perform the duties of the GTA, giving expert advice on the actions necessary to protect the public. They would advise on the expected course of the emergency and potential radiological consequences. On the arrival of the GTA, it would be important to achieve a smooth handover: the technical advisor would give a technical briefing on the situation and review any advice that had already been given. The technical advisor would remain available as support to the SCC and GTA in assembling all technical information relating to the accident.

4.5.12. Recovery

The responsibility for recovery is placed on the licensee who works closely with the local authority which continues to co-ordinate the response. The main priority is to ensure that recovery activities restore the site to a stable and safe condition. It is the duty of the licensee to provide resources to support the off-site Recovery Working Group that will evolve from the Strategic Coordinating Group. The licensee will continue to provide monitoring support and advice on transport, storage and disposal of radioactive waste.

There would be both internal and external investigations and processes would have to be established to deal with all inquiries and to make sure that all information is readily available and archived appropriately.

4.6. ORGANISATION

Once the staff structure and site organisation have been fully developed, specific site arrangements will be written to include the detailed information listed below.

4.6.1. Resources: Facilities, Staff and Equipment

The plans will include a list of positions and their responsibilities during an emergency. This, for example, may include; employees to set the procedures in motion and co-ordinate resulting action; to notify and liaise with the local authority; to be the ‘technical advisor’ to the off-site facility, especially before the arrival of the GTA; to be responsible for authorisation of on-site distribution of potassium iodate tablets; to manage emergency exposures and authorise personnel to receive emergency exposures; to secure the site; to act as medical and radiation protection advisors and other personnel with media briefing responsibilities.

Detailed information regarding the facilities and back up facilities will be given, including information on the remote shutdown station, on facilities to secure and manage the site and on areas to treat invalids, brief the media, receive and equip emergency teams and on control of access to the damaged area.

Documentation will describe emergency equipment necessary to implement the plans and protect the emergency response teams. Monitoring, communication and dose assessment systems will also be documented.

Arrangements with other power stations will be made to provide support in the form of both equipment and human resources.

4.6.2. Training, exercises, review and revision

On-site exercises would be held regularly with the participation of external organisations encouraged. These exercises would test the adequacy and comprehensiveness of the plan and the competency of the staff to carry out their duties. The exercises would also ensure that facilities and equipment were sufficient and were operable under emergency conditions. Regulations require that the SCC is exercised at least once every three years with a full exercise undertaken every 6 years. The licensee would be required to be involved in these exercises as it has a key role in the SCC and the on-site and off-site responses must be carefully co-ordinated.

Lessons learned from these exercises would be integrated into the review process. Review and revision would take place regularly to ensure that any changes to site and staff are incorporated into the plan. All changes to the plan would be communicated with the relevant external agencies.

All staff would receive regular training to ensure that they were able to carry out their duties in an emergency. Staff would only participate in exercises having had prior training. Demonstration Exercises would not form part of the training itself, but would provide a method of demonstrating the skills that had been learnt. Other emergency exercises would provide the opportunity to practise communication and practical skills required.

Detailed schedules, exercise plans and training arrangements would be developed in the site licensing phase.

4.6.3. External collaboration

Consultation and collaboration between all agencies involved, whilst developing the on-site and off-site plans, would be essential to ensure that the plans run smoothly and the organisations can each perform their duties effectively. A notification chain would be drawn up to ensure that in the event of an emergency all organisations were notified efficiently.

The strategy to supply the public with prior information regarding emergency procedures and information would be developed with the local authority. The method for the distribution of stable iodine tablets would be devised in consultation with the local authority, although the tablets would be provided by the licensee.

4.6.4. Other Incidents

The infrastructure and training provided for the nuclear emergency would be utilised to provide non-nuclear site responses to situations. These could be, for example, chemical spills where the consequences of the event are retained on site, or fires or other similar events.

SUB-CHAPTER 18.3 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

2. EMERGENCY OPERATING PROCEDURES FOR DESIGN BASIS TRANSIENTS, INCIDENT AND ACCIDENT CONDITIONS

2.0. SAFETY REQUIREMENTS

2.0.2. Rules governing operating documentation

[Ref-1] Procedure ENG 3-34: Content and structure of an Emergency Operating rule. ECEF061266 Revision A1. EDF. April 2009. (E)

ECEF061266 Revision A1 is the English translation of ECEF061266 Revision A.

[Ref-2] Procedure EPR ENG 3-40: Content and structure of Emergency Operating methods. ECEF061275 Revision A1. EDF. July 2009. (E)

ECEF061275 Revision A1 is the English translation of ECEF061275 Revision A.

2.1. THE STATE ORIENTED APPROACH

2.1.1 Main principles

[Ref-1] State-Oriented Approach designer knowledge transfer. ENFCRI090272 Revision A. EDF. November 2009. (E)

ENFCRI090272 Revision A is the English translation of ENFCRI080034 Revision A.

[Ref-2] SOA designer knowledge transfer - Appendix 1. ENFCRI090295 Revision A. EDF. December 2009. (E)

ENFCRI090295 Revision A is the English translation of ENFCRI080224 Revision A.

2.1.2. Automatic Diagnosis (AD)

[Ref-1] EPR HMI - Evaluation of the Principles of computerised operation - assessment of the 2005 supplementary test campaign. ECEF060191 Revision A1. EDF. March 2010. (E)

ECEF060191 Revision A1 is the English translation of ECEF060191 Revision A.

[Ref-2] Automatic diagnosis principles for EPR emergency operation. ECEF050143 Revision C1. EDF. February 2012. (E)

3. OPERATING PRINCIPLES FOR SEVERE ACCIDENT CONDITIONS

3.1. FIELD TO BE COVERED

[Ref-1] Principles to be used for the implementation of the Non-Computerised Safety System for Emergency Operating Procedure. ECEF100659 Revision A. EDF. March 2010. (E)

[Ref-2] EPR UK Functional requirements on Non-Computerised Safety I&C and functions. NEPR-F DC 551 Revision C. AREVA. July 2012. (E)

3.4. OPERATING PRINCIPLES

[Ref-1] Severe Accident Management Operating Strategies for Severe Accidents FA3. NEPS-F DC 457 Revision A. AREVA. June 2009. (E)

4. EMERGENCY PREPAREDNESS

4.1. INTRODUCTION AND REGULATORY FRAMEWORK

[Ref-1] A Guide to the Radiation (Emergency Preparedness and Public Information) Regulations 2001. ISBN 0 7176 2240 1. HSE. (E)

4.4. DEFINITIONS OF EMERGENCY AND RELEVANT SITUATIONS

[Ref-1] A Guide to the Radiation (Emergency Preparedness and Public Information) Regulations 2001. ISBN 0 7176 2240 1. HSE. (E)

4.5. RESPONSE

4.5.7. Personal dose assessments

[Ref-1] The Ionising Radiations Regulations 1999. Statutory Instrument 1999 No. 3232. ISBN 0 11-085614-7. The Stationery Office Ltd. (E)