UK EPR	Title: PCSR – Sub-chapter 6.6 – Emergency Feedwater System (ASG) [EFWS]
	UKEPR-0002-066 Issue 03

Total number of pages: 21	Page No.: I / IV
Chapter Pilot: JP. BOURRET *Name/Initials* J.P. BOURRET *Date* *21-03-2011*	
Approved for EDF by: A. PETIT *Name/Initials* *Date* *26-03-2011*	Approved for AREVA by: C. WOOLDRIDGE *Name/Initials* C.Wooldridge *Date* *25-03-2011*

REVISION HISTORY

Issue	Description	Date
00	First issue for INSA information	11/12/2007
01	Integration of technical and co-applicant comments	29/04/2008
02	PCSR June 2009 update: – Clarification of text, – Inclusion of references.	26-06-2009
03	Consolidated Step 4 PCSR update: – Minor editorial changes – Update and inclusion of references	26-03-2011

Text within this document that is enclosed within curly brackets "{…}" is AREVA or EDF Commercially Confidential Information and has been removed.

For information address:

AREVA NP SAS

An AREVA and Siemens Company
Tour AREVA
92084 Paris La Défense Cedex
France

EDF

Division Ingénierie Nucléaire
Centre National d'Equipement Nucléaire

165-173, avenue Pierre Brossolette
BP900

92542 Montrouge
France

TABLE OF CONTENTS

SUB-CHAPTER 6.6 - EMERGENCY FEEDWATER SYSTEM (ASG [EFWS]) [REF]

0. SAFETY REQUIREMENTS

0.1. SAFETY FUNCTIONS

The ASG [EFWS] contributes to the three basic safety functions as follows:

1) Reactivity control

The ASG [EFWS] allows the affected Steam Generator (SG) to be isolated in the event of a Main Steam Line Break (MSLB) to ensure core sub-criticality in the controlled state.

2) Residual heat removal

The ASG [EFWS] enables:

- Residual heat to be removed from the primary cooling system in certain PCC-2, PCC-3, PCC-4 or RRC-A events.
- The primary cooling system to be partially cooled down by the steam generators in certain PCC-3, PCC-4 or RRC-A events to return it to Medium-Head Safety Injection (MHSI) conditions (e.g. small break LOCA or SGTR).
- The primary cooling system to be fast cooled down to Low-Head Safety Injection (LHSI) injection conditions following RRC-A category events (e.g. small break LOCA + total failure of the MHSI).
- The primary cooling system to be cooled to RRA [RHRS] connection conditions following a PCC-2, PCC-3, PCC-4 or RRC-A event.
- Sufficient capacity to be provided to maintain the primary cooling system at hot shutdown conditions for 24 hours (Station Black-out (SBO)/Loss of Ultimate Heat Sink (LUHS) with ASG [EFWS] water storage tanks only).
- Cooldown to RRA [RHRS] connection conditions and residual heat removal over 100 hours to be carried out by replenishment of the ASG [EFWS] tanks if ultimate cooling water is lost (LUHS – Loss of Ultimate Heat Sink).

3) Containment of radioactive substances

The ASG [EFWS] enables the affected SG to be isolated to prevent the creation of a containment bypass route in the event of SGTR.

The ASG [EFWS] enables the affected SG to be isolated to limit the containment pressure and temperature in the event of Feed Water Line Break (FWLB) or Main Steam Line Break (MSLB).

0.2. FUNCTIONAL CRITERIA

In order to perform its safety functions during any PCC or RRC-A event, the ASG [EFWS] meets the following criteria:

Emergency feedwater injection to the SGs

The ASG [EFWS] provides the minimum feedwater injection flow rate to the SG required in the limiting design basis condition (primary cooling system cooldown to RRA [RHRS] connection conditions following an FWLB (PCC-4 event)).

The ASG [EFWS] limits the feedwater injection flow rate to the affected SG when it is depressurised following FWLB.

Emergency feedwater storage capacity

The ASG [EFWS] tanks contain sufficient water for the limiting design basis condition (primary cooling system cooldown to RRA [RHRS] connection conditions following FWLB (PCC-4 event)).

The ASG [EFWS] tanks provide sufficient water following LUHS or SBO conditions lasting for 24 hours.

It is possible to replenish the ASG [EFWS] tanks in the event of LUHS lasting for 100 hours.

Isolation capacity

In the event of SGTR, the ASG [EFWS] ensures containment of activity within the affected SG.

In the event of MSLB or FWLB, the ASG [EFWS] ensures core subcriticality and containment integrity by isolating the affected SG.

0.3. DESIGN REQUIREMENTS

0.3.1. Requirements arising from safety classifications

Safety classification

To carry out its safety functions, the ASG [EFWS] is classified in accordance with the requirements of Sub-chapter 3.2.

Single failure criterion

The single failure criterion is applied to active components that provide an F1 function to ensure adequate redundancy.

The ASG [EFWS] is used in the short-term (up to 24 hours) during PCC-2 to PCC-4 events, therefore the passive single failure criterion is not applied. However, this criterion is applied to the "passive headers" which enable the four trains to be interconnected, as described in Sub-chapter 14.2.

Emergency power supplies

The power supply for the electrical equipment is provided by four independent electrical divisions backed-up by the main diesel generator sets. The time to achieve full feedwater injection flow rate coincident with loss of external power supplies (LOOP) is an input condition for the accident studies.

Also, to cover station blackout, two trains (division 1 and 4) are each further backed-up by an SBO diesel generator set.

Qualification to operating conditions

The ASG [EFWS] equipment that fulfils F1 and F2 functions is qualified to remain functional under normal and accident operating conditions in accordance with Sub-chapter 3.6.

Mechanical, electrical and I&C classifications

The mechanical, electrical and I&C ASG [EFWS] equipment is classified in accordance with the classification principles described in Sub-chapter 3.2.

Seismic classification

The ASG [EFWS] is able to perform its safety functions in the event of an earthquake, in accordance with the classification rules described in Sub-chapter 3.2.

0.3.2. Other regulatory requirements

Basic safety rules

The ASG [EFWS] complies with the regulatory requirements presented in Sub-chapter 1.4.

Technical guidelines specific to the ASG [EFWS] (Sub-chapter 3.1)

The following Technical Guidelines are applicable:

- Single failure criterion and preventive maintenance
- Acceptance criteria

0.3.3. Hazards

General layout provisions ensure that the ASG [EFWS] is protected against internal and external hazards in accordance with Chapter 13.

0.4. TESTING

Pre-operational tests

The ASG [EFWS] is designed to enable pre-operational tests to be carried out as follows:

- Verification of water storage capacity (instrumentation)

- Verification of the feedwater injection capacity (injection capacity of pumps and flow rate required in the various configurations, RPR [PS] (reactor protection system) demands associated with pumps and valves)

- Verification of the isolation capacity (RPR [PS] demands on SG high level signal, isolation valve closing time)

In-service monitoring and inspection

The ASG [EFWS] is designed to enable the availability of its various components to be confirmed during normal operation, and also to facilitate in-service inspections.

Periodic tests

The ASG [EFWS] is designed to allow periodic tests to be carried out to confirm its capability to meet its safety functional requirements.

1. SYSTEM ROLES

1.1. OPERATIONAL ROLE

The ASG [EFWS] does not have a role in normal plant operation since the SGs are supplied by the ARE [MFWS] in normal operations and the Start-up and Shutdown Feedwater System (AAD [SSS]) during start-up/shutdown phases. The ASG [EFWS] only performs a safety role.

1.2. SAFETY ROLE

In the event that the normal operation SG feedwater systems (ARE [MFWS] and AAD [SSS]) become unavailable, then the ASG [EFWS] supplies the necessary feedwater. The ASG [EFWS] removes residual heat via the atmospheric relief system (VDA [MSRT]) or the main steam safety valves (MSSVs) in the event of a reactor trip following continuous operation at the nominal power of 4500 MW, thus allowing the reactor to achieve a safe shutdown state.

General safety requirements are given in section 0.

2. DESIGN BASES

2.1. BASIC DESIGN CONDITIONS [REF]

Injection flow rate

The bounding design requirement for ASG [EFWS] flow rate is a feedwater line break (PCC-4 event) with a postulated failure of one of the four ASG [EFWS] pumps.

The minimum ASG [EFWS] flow rate required under these conditions is 90 Mg/h per SG at the setpoint of the main steam relief valves (95.5 bar abs + 1.5 bar uncertainty).

In the event of total loss of the VDA [MRST], the ASG [EFWS] pump supplies at least the minimum required flow rate of 28 Mg/h per SG at 106.5 bar abs (MSSV setpoint + uncertainty).

The maximum flow rate injected into a depressurised SG does not exceed 200 Mg/h. If the flow limitation control is in service, the ASG [EFWS] flow rate is limited to approximately 95 m^3/h, regardless of SG pressure.

The maximum temperature of the ASG [EFWS] water injected into the SG does not exceed 60°C at the end of the bounding transient.

Single failure criterion and preventive maintenance

The ASG [EFWS] considers the single failure criterion in accordance with Sub-chapter 14.2. The design of pump suction headers and discharge headers allows a train to be unavailable for preventive maintenance whilst still allowing for the possibility of a single failure occurring simultaneously in another train. The design basis case is rupture of a feedwater pipe (FWLB) for which one SG must additionally be isolated. After isolating the affected SG, the associated ASG [EFWS] pump, which is assumed to be available, is then used via the discharge side header to supply feedwater to an intact SG (see Chapter 14).

Minimum feedwater storage

The minimum ASG [EFWS] water storage requirement, defined for the bounding transient, i.e. primary cooling system cooldown to RRA [RHRS] connection conditions following FWLB with an assumed passive single failure (i.e. loss of one ASG [EFWS] tank), is 1112 Mg.

The total ASG [EFWS] water storage capacity is shared between four tanks whose useful water volume is 386 m^3 for each of the division 2 and 3 tanks and 431 m^3 for each of the division 1 and 4 tanks. These tanks do not need to be replenished during design basis transients (PCC-2 to PCC-4). Headers between the four trains at the pump suction enable all of the stored water to be used even if one train fails.

The ASG [EFWS] tank capacity is adequate to maintain the plant in hot shutdown conditions for 24 hours.

Re-supplying the ASG [EFWS] tanks from a 2600 m^3 reserve supply, 800 m^3 of which is shared with the JAC system (fire fighting water supply system), extends the capability to 100 hours.

One ASG [EFWS] train (division 1 or 4) may become unavailable due to an aircraft crash. Under these circumstances the three other ASG [EFWS] trains remain unaffected and are able to return the primary cooling system to RRA [RHRS] connection conditions.

ASG [EFWS] isolation

ASG [EFWS] isolation is required on a SG affected by SGTR, MSLB or FWLB. It is automatically actuated for SGTR on a SG high level signal. ASG [EFWS] isolation is manually triggered for FWLB or MSLB events.

Isolation function redundancy is provided by simultaneous closing of the isolation valve and the SG level control valve.

2.2. AVAILABILITY

The ASG [EFWS] must be available during all plant states for which the SGs are required.

2.3. CHOICE OF MATERIALS

Since ASG [EFWS] water is not degassed, all of the pipes and equipment (except for the concrete tanks) are made of stainless steel.

2.4. AUTOMATIC CONTROL PRINCIPLES

The ASG [EFWS] has the following automatic control functions:

- Start-up of each ASG [EFWS] train on a SG low level signal
- ASG [EFWS] start-up on Safety Injection (SI) + LOOP signal
- Isolation of an ASG [EFWS] train on a SG high level signal
- Protection of pumps against excessive flow rates (risk of cavitation, electric motor overload)
- SG level control

3. SYSTEM DESCRIPTION AND EQUIPMENT CHARACTERISTICS

3.1. GENERAL DESCRIPTION

The ASG [EFWS] comprises:

- Four identical trains located in safeguard buildings 1 to 4 and the reactor building, which are supplied by four independent, geographically segregated, electrical divisions
- Two headers located in the safeguard buildings. These headers are equipped with manual isolation valves between each train (closed during normal plant operation)
    - The suction side header line connects the ASG [EFWS] tanks in each train upstream of the pumps
    - The discharge side header line connects the injection lines of each train downstream of the pumps.
- A supply line from the demineralisation plant water supply system (SER) is connected to the suction side header line
- The ASG [EFWS] tank replenishment system consists of:
    - A storage tank holding approximately 2600 m^3 of demineralised water, shared by the ASG [EFWS] and the fire fighting water supply system (JAC) and located below the pre-discharge structure (see Chapter 9)
    - 2 motor-driven ASG [EFWS] pumps also located below the pre-discharge structure

- 2 pipelines connected to the suction side header in division 2 and 3.

Each ASG [EFWS] train consists of the following equipment:

- A storage tank { CCI Removed } [b]
- An electric motor-driven pump { CCI Removed } [b]
- A flow limitation control valve { CCI Removed } [b]
- A SG level control valve { CCI Removed } [b]
- An electric motor-operated isolation valve { CCI Removed } [b]

All of this equipment is located in the non-controlled areas of the safeguard buildings.

3.2. EQUIPMENT CHARACTERISTICS [REF]

Note: The characteristics below are preliminary values which will be confirmed during the detailed design phase.

3.2.1. ASG [EFWS] main electric motor-driven pumps

The ASG [EFWS] main electric motor-driven pumps are centrifugal pumps. Each pump delivers its required flow rate and head at a grid frequency of 50 Hz. Pump characteristic data are presented in the following table:

Flow rate	98 m^3/h
Pump head at flow rate	1259 m
Supply voltage	690 V (trains 1 and 4) 10 kV (trains 2 and 3)

Each pump is equipped with an automatic miniflow line isolation device (free flow check valve). If the flow rate injected into the SG is less than the miniflow value adjusted at the free flow check valve, then the miniflow line opens and ensures that the pump delivers at least the miniflow value. This protects the pump from damage.

In the event of injection to a depressurised SG the ASG [EFWS] flow rate is limited by an automatic flow limitation control valve associated with each pump.

The pump motor and bearings are cooled by the ASG [EFWS] fluid itself, which is returned to the ASG [EFWS] tanks via the miniflow line from the downstream side of the heat exchanger.

The pump motors are emergency-powered by the main diesel generator sets. Division 2 and 3 pumps are supplied via the 10 kV switchboards. Division 1 and 4 pumps are supplied via the 690 V switchboards which are backed-up by the SBO diesel generators. For this reason, the electrical power of the pumps in these two divisions is limited to approximately 500 kW by automatic action of the flow limitation control valves.

3.2.2. ASG [EFWS] electric motor-driven replenishing pump

The electric motor-driven pump used to replenish the ASG [EFWS] tanks has a nominal capacity of 100 m^3/h. Back-up power is supplied to the pump motor by a main diesel generator set and an SBO diesel generator, for use in the event of a long term LOOP.

3.2.3. Storage tanks

The ASG [EFWS] storage tanks are made of concrete and have an internal liner.

Tank characteristics:

Water temperature	10°C to 50°C and max. 60°C at the end of the bounding transient (24 h SBO)
Required net water mass	Div. 1, 2, 3, 4: 375 Mg

3.2.4. Shared ASG [EFWS] / fire fighting water tank

See Sub-chapter 9.5.

3.2.5. Control valves

The control valves are electrically operated.

The flow limitation control valves located at pump discharge lines are designed to limit feedwater injection to depressurised SGs and consequently limit the pump motor power. This is particularly important for divisions 1 and 4, which are supplied with 690 V (low voltage) power.

4. PHYSICAL PHENOMENA DETERMINING ASG [EFWS] OPERATION

4.1. NORMAL PLANT OPERATION

Under normal plant operating conditions, the ASG [EFWS] is shutdown, i.e.:

- The ASG [EFWS] pumps are shut-down and available, ready for start-up
- The flow limitation control valves are closed on their mechanical stops
- The SG level control valves are open
- The external containment isolation valves are open
- The manual valves of the upstream header are closed
- The manual valves of the downstream header are closed
- The ASG [EFWS] tanks are full of water.

4.2. ASG [EFWS] STEADY STATE OPERATING CONDITIONS

ASG [EFWS] steady state operating conditions are as follows:

4.2.1. Conditions related to feedwater storage

- The tanks are filled during reactor shutdown after use of the ASG [EFWS] or after periodic tests
- ASG [EFWS] tanks can be interconnected by opening the manual valves in the header line upstream of the pumps
- ASG [EFWS] tank replenishment is achieved via the header line upstream of the pumps.

4.2.2. Conditions related to feedwater pumping and injection

- Operations initiated by the operator:
  - Isolation of the affected SG in the event of FWLB or MSLB
  - Interconnection of ASG [EFWS] trains by opening the manual valves in the header lines upstream/downstream of the pumps
  - Periodic testing
- Operations initiated by a protection signal:
  - Automatic ASG [EFWS] start-up on SG low level signal or Safety Injection (SI) + LOOP
  - SG isolation on SG high level signal to avoid SG overfilling and to ensure confinement of radioactivity in the event of SGTR.

4.3. ASG [EFWS] TRANSIENT OPERATING CONDITIONS

4.3.1. System start-up

On loss of operational SG feedwater supply, the ASG [EFWS] is automatically started by a SG low level signal. Each ASG [EFWS] train is started separately.

The SG low level signal results in the following:

- Reactor trip
- Start-up of the pump in the associated train
- Activation, or confirmation of activation, of the flow limitation control
- Opening, or confirmation of the opening, of the containment isolation valve
- Activation of the ASG [EFWS] start-up alarm

The time required to achieve full ASG [EFWS] flow is ≤ 16.5 s without LOOP (no loss of external power supplies) and ≤ 51.5 seconds with LOOP (power supplied by the main diesel generator sets) [Ref].

4.3.2. Isolation of an ASG [EFWS] train

Following MSLB or FWLB, it is possible to isolate the ASG [EFWS] train of the affected SG manually from the main control room to limit overpressure in the containment and to maintain the integrity of the third barrier. Isolating the affected SG also avoids draining the ASG [EFWS] tank in the affected train.

Following SGTR, automatic isolation of the affected SG (on a SG high level signal) is required to confine activity within the SG.

Automatic isolation leads to:

- Containment isolation valve closure
- SG level control valve closure.

4.3.3. SG level control

Automatic control of the ASG [EFWS] flow rate maintains the SG level at its setpoint.

4.3.4. Opening of inter-tank header (at pump suction side)

If one pump becomes unavailable (due to failure or preventive maintenance), then opening of the inter-tank header valves allows the water inventory of the associated ASG [EFWS] tank to be used.

This manual action is performed locally in the header room.

4.3.5. Opening of SG injection header (at pump discharge side)

Opening the SG injection header valves at the pump discharge side allows a pump in a train whose SG is unavailable, to be used to supply feedwater to an intact SG.

This manual action is performed locally in the header room.

4.3.6. Replenishing ASG [EFWS] storage tanks

On detection of low level in the ASG [EFWS] tanks, the dedicated replenishing pump is manually aligned and started to replenish the tanks.

4.3.7. Filling ASG [EFWS] tanks

The ASG [EFWS] tanks are normally filled by opening the motor-operated valve connected to the demineralised water distribution system (SER).

5. PRELIMINARY SAFETY ANALYSIS

5.1. COMPLIANCE WITH REGULATIONS

Compliance with the general regulations is addressed in Sub-chapter 1.4.

5.2. COMPLIANCE WITH FUNCTIONAL CRITERIA

The ASG [EFWS] is designed to remove residual heat so that the primary cooling system fuel limits and other design limits are not exceeded. Section 2.1 presents the ASG [EFWS] design requirements.

The design basis condition used for defining ASG [EFWS] injection flow rate is a feedwater line break (PCC-4 event) together with failure of one of the four ASG [EFWS] pumps. This bounds the other accident and incident conditions described in Chapters 14 and 16.

The ASG [EFWS] water storage capacity is designed to accommodate the most demanding transient for feedwater consumption (PCC-4 FWLB), and to maintain the primary cooling system at hot shutdown conditions for 24 hours (SBO, LUHS) without replenishing the ASG [EFWS] storage tanks.

Provisions are made for ASG [EFWS] replenishment in the event of LUHS conditions lasting up to 100 hours.

5.3. COMPLIANCE WITH DESIGN REQUIREMENTS

5.3.1. Safety classification

The compliance of equipment design and construction with the rules for safety classification is detailed in Sub-chapter 3.2.

5.3.2. Single Failure Criterion (redundancy)

The four ASG [EFWS] trains are designed to comply with the single failure criterion. Each of the trains is located in a different division of the safeguards building. Divisions 2 and 3 are protected against direct aircraft impact by appropriate layout design. Divisions 1 and 4 meet the requirements for protection against aircraft crash by geographical separation (only one train can be destroyed).

The redundancy of the isolation function is provided by simultaneous closing of the containment isolation valve and the SG level control valve.

5.3.3. Qualification

The ASG [EFWS] equipment is qualified in accordance with the requirements presented in Sub-chapter 3.6.

5.3.4. Instrumentation and Control (I&C)

The compliance of equipment design and construction with the rules for I&C safety classification is addressed in Sub-chapter 3.2.

5.3.5. Emergency power supplies

In the event of an LOOP (loss of off-site power), the ASG [EFWS] pumps, including the replenishing pump, are backed-up by the main diesel generator sets.

In the event of an SBO, the ASG [EFWS] trains 1 and 4 and the ASG [EFWS] replenishing pump are backed-up by the SBO diesel generator sets.

5.3.5.1. Hazards

The following tables summarise the protection against hazards for the ASG [EFWS] (excluding replenishment).

Internal hazards	Protection required in principle	General protection	Specific protection inherent in system design
Pipe breaks	Loss of not more than one train. No loss of secondary system integrity.	Physical separation	-
Tank, pump and valve leakages		Physical separation	-
Internal missiles		Physical separation	-
Dropped loads		Physical separation	-
Internal explosion		Physical separation	-
Fire		Location in four divisions (excluding the Reactor Building (RB)) Fire sectors in the RB	-
Internal flooding		Location in four divisions (excluding the RB)	-

External hazards	Protection required in principle	General protection	Specific protection inherent in system design
Earthquake	Yes	Location in the Safeguards Buildings (SBs) and the RB	Seismic design
Aircraft crash	Yes	Location in the SBs and the RB	-
External explosion	Yes	Location in the SBs and the RB	-
External flooding	Yes	Location in the SBs and the RB	-
Snow and wind	Yes	Location in the SBs and the RB	-
Extreme cold	Yes	Location in the SBs and the RB	-
Electromagnetic interference	Yes	Location in the SBs and the RB	-

Hazards credited for ASG [EFWS] tank replenishment

Internal hazards	**Protection required in principle**	**General protection**	**Specific protection inherent in system design**
Pipe breaks	No		-
Tank, valve and pump leakages			-
Internal missiles			-
Dropped loads			-
Internal explosion			-
Fire			-
Internal flooding			-

External hazards	**Protection required in principle**	**General protection**	**Specific protection inherent in system design**
Earthquake	Yes	Location in the pumping station, tunnels and SBs	Seismic design
Aircraft crash	No	Location in the pumping station, tunnels and SBs	-
External explosion	No	Location in the pumping station, tunnels and SBs	-
External flooding	Yes	Location in the pumping station, tunnels and SBs	-
Snow and wind	Yes	Location in the pumping station, tunnels and SBs	-
Extreme cold	Yes	Location in the pumping station, tunnels and SBs	-
Electromagnetic interference	No	Location in the pumping station, tunnels and SBs	-

6. TESTING, INSPECTION AND MAINTENANCE

6.1. INSPECTION AND MAINTENANCE

It is possible to perform preventive maintenance on one ASG [EFWS] train with the reactor in operation. The level of maintenance performed at power, which is mainly limited to the pumps, will depend on the requalification possibilities provided by the plant. Equipment requalification will be studied during the detailed design stage.

Since the total capacity of the four ASG [EFWS] tanks and SG feedwater injection lines is required at power, no preventive maintenance is planned on this equipment whilst the unit is operating.

6.2. PERIODIC TESTS

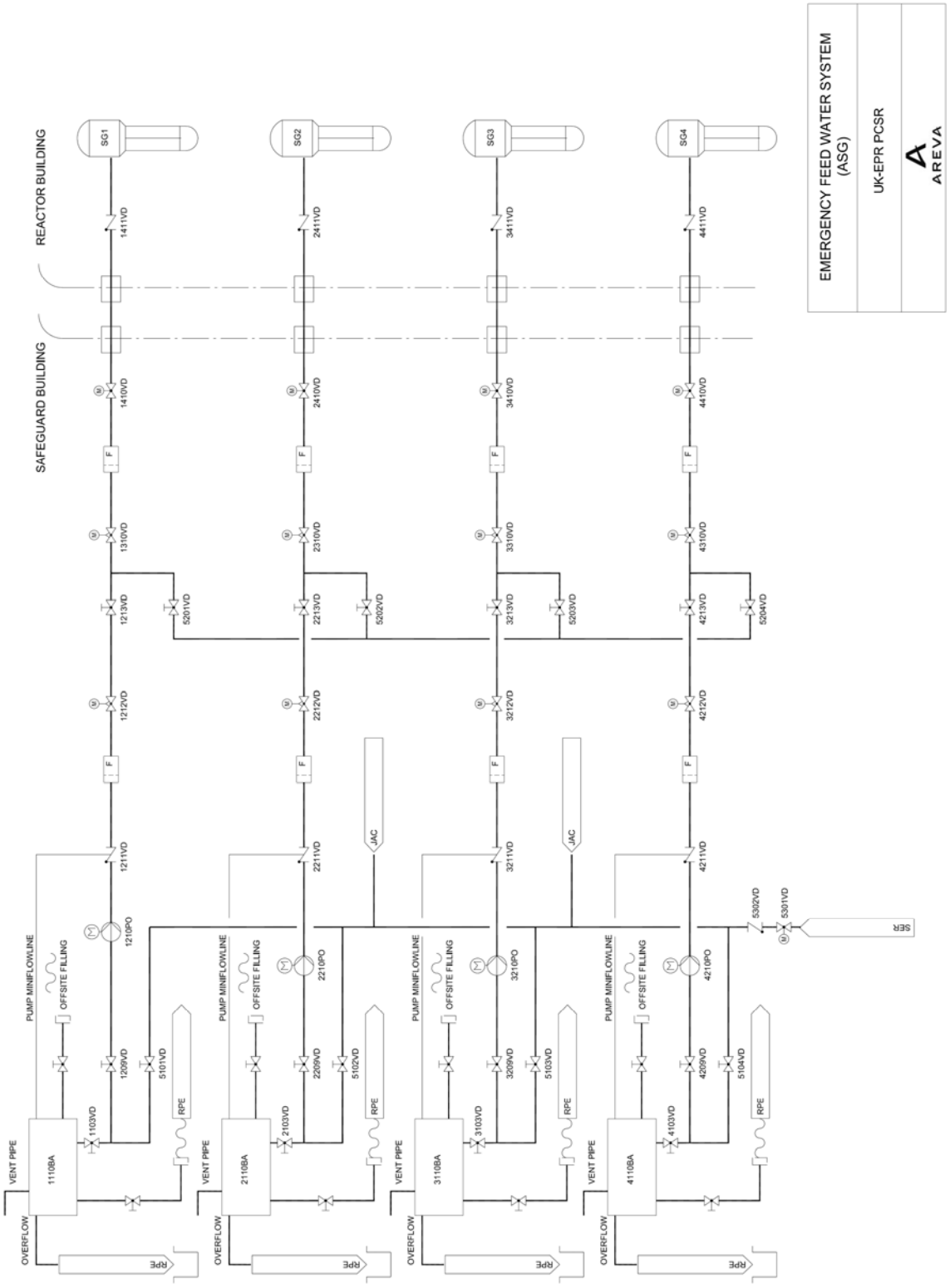
Periodic testing is planned to confirm that the safety criteria are met and to confirm the capability of the ASG [EFWS] to fulfil its safety functions.

7. MECHANICAL FLOW DIAGRAM

See Sub-chapter 6.6 - Figure 1.

SUB-CHAPTER 6.6 - FIGURE 1

Emergency Feedwater System



SUB-CHAPTER 6.6 – REFERENCES

External references are identified within this sub-chapter by the text **[Ref]** 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.

[Ref] F Fioravanti. System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P2 – System operation. SFL-EFMF 2006.829 Revision E1. SOFINEL. September 2009. (E)

SFL-EFMF 2006.829 Revision E1 is the English translation of SFL-EFMF 2006.829 Revision E PREL.

[Ref] F Fioravanti. System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P3 – System and component design. EYTF/2007/fr/0052 Revision C1. EDF. September 2009. (E)

EYTF/2007/fr/0052 Revision C1 is the English translation of EYTF/2007/fr/0052 Revision C BPE.

[Ref] System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P4. – Flow diagrams. SFL-EF MF 2006.746 Revision D1. SOFINEL. September 2009. (E)

SLF-EF MF 2006.746 Revision D1 is the English translation of SLF-EF MF 2006.746 Revision D PREL.

[Ref] Dossier de Système Elémentaire - ASG (EFWS) Alimentation de secours GV, P4.2 Schémas mécaniques détaillés.
[System Design Manual - Emergency Steam Generator Feedwater System (EFWS), P4.2 Detailed Flow Diagrams]
EYTF2007FR0031 Revision D. EDF. May 2008.

[Ref] System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P5 – Instrumentation and Control. EYTF/2006/fr/0011 Revision F1. EDF. September 2009. (E)

EYTF/2006/fr/0011 Revision F1 is the English translation of EYTF/2006/fr/0011 Revision F BPE.

2. DESIGN BASES

2.1. BASIC DESIGN CONDITIONS

[Ref] F Fioravanti. System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P2 – System operation. SFL-EFMF 2006.829 Revision E1. SOFINEL. September 2009. (E)

SFL-EFMF 2006.829 Revision E1 is the English translation of SFL-EFMF 2006.829 Revision E PREL.

3. SYSTEM DESCRIPTION AND EQUIPMENT CHARACTERISTICS

3.2. EQUIPMENT CHARACTERISTICS

[Ref] F Fioravanti. System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P2 – System operation. SFL-EFMF 2006.829 Revision E1. SOFINEL. September 2009. (E)

SFL-EFMF 2006.829 Revision E1 is the English translation of SFL-EFMF 2006.829 Revision E PREL.

[Ref] F Fioravanti. System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P3 – System and component design. EYTF/2007/fr/0052 Revision C1. EDF. September 2009. (E)

EYTF/2007/fr/0052 Revision C1 is the English translation of EYTF/2007/fr/0052 Revision C BPE.

4.3. ASG [EFWS] TRANSIENT OPERATING CONDITIONS

4.3.1 System start-up

[Ref] F Fioravanti. System Design Manual – Emergency Steam Generator Feedwater System (EFWS), P2 – System operation. SFL-EFMF 2006.829 Revision E1. SOFINEL. September 2009. (E)

SFL-EFMF 2006.829 Revision E1 is the English translation of SFL-EFMF 2006.829 Revision E PREL..