Form10/00

UK ABWR

Document ID	:	GA91-9101-0101-18002
Document Number	:	WE-GD-0019
Revision Number	:	A

UK ABWR Generic Design Assessment

Generic PCSR Sub-chapter 18.2 : Liquid Radioactive Waste Management System

Hitachi-GE Nuclear Energy, Ltd.

DISCLAIMERS

Proprietary Information

This document contains proprietary information of Hitachi-GE Nuclear Energy, Ltd. (Hitachi-GE), its suppliers and subcontractors. This document and the information it contains shall not, in whole or in part, be used for any purpose other than for the Generic Design Assessment (GDA) of Hitachi-GE's UK ABWR. This notice shall be included on any complete or partial reproduction of this document or the information it contains.

Copyright

Table of Contents

18.2.1 Overview 18.2-1
18.2.2 Design Basis 18.2-2
18.2.2.1 Safety Requirement 18.2-2
18.2.2.2 Functional Requirement 18.2-4
18.2.2.3 Design Related Requirement 18.2-4
18.2.2.4 Design Criteria 18.2-4
18.2.3 System Description 18.2-5
18.2.3.1 Radioactive Drain Transfer System 18.2-5
18.2.3.2 Low Conductivity Subsystem 18.2-6
18.2.3.3 High Conductivity Subsystem 18.2-7
18.2.3.4 Laundry Drain Subsystem 18.2-8
18.2.3.5 Controlled Area Drains Subsystem 18.2-9
18.2.3.6 Waste Water Treatment Secondary Waste Storage 18.2-10
18.2.4 References 18.2-15

18.2.1 Overview

The Advanced Boiling Water Reactor (ABWR) Liquid Radioactive Waste Management System (LWMS) is designed to segregate at source, collect and treat the various streams of radioactive and potentially radioactive waste water generated during commercial operation of ABWR reactor and turbine: start-up, power operation, system shutdown, and refuelling outage. A schematic drawing of the LWMS is given in Figure 18.2-1.

The LWMS is housed in the Radioactive Waste Building (Rw/B) and Service Building (S/B), and consists of the following four subsystems:

- Low Conductivity Waste (LCW) subsystem in Rw/B
- High Conductivity Waste (HCW) subsystem in Rw/B
- Laundry Drains (LD) subsystem in S/B
- Controlled Area Drains (CAD) subsystem in Rw/B

The Primary Circuit and Fuel Pool (i.e. the plant areas containing water that comes into direct contact with irradiated fuel) are operated as far as is practicable as “closed loop systems”. For this reason, the LWMS is designed so that any water leaks and any water drained from the Primary Circuit or Fuel Pool during commercial operation of plant is captured and appropriately treated so as to remove both soluble and in-soluble impurities. This provides a high purity water that is normally recycled for use in the Primary Circuit and/or Fuel Pool. Recycled water is only occasionally discharged from the HCW subsystem to the environment (through a permitted route) when the recycled volumes exceed Primary Circuit and Fuel Pool water make-up requirements. On occasions when it is necessary to discharge excess volumes of treated water to the environment, the treated water is first monitored to ensure that residual levels of contamination are within set limits and As Low As Reasonably Practicable (ALARP).

Two subsystems are used to treat radioactively contaminated waste water from the Primary Circuit and/or Fuel Pool, the HCW subsystem and the LCW subsystem. Waste water is captured and routed to the appropriate subsystems depending on its expected conductivity, i.e. the expected level of impurities (including non-radiological contamination) it contains. The HCW subsystem is designed to efficiently treat water with higher levels of impurities level by the use of a distillation step before treating the distilled water by passing it through an ion exchange bed. The LCW subsystem is designed to efficiently treat larger volumes of water which contain lower levels of impurities and uses an initial filtration (rather than distillation) step before passing the filtered water through an ion exchange bed. In both cases, if necessary, waste water can be passed through the treatment process a number of times in order to meet the purity levels required for reuse.

The LD subsystem is used to treat waste water from the laundry and the personnel showers and hand washing facilities. This water contains detergents and organic impurities as well as crud with low levels of radiological contamination. Efficient removal of the detergents and organic material (as well as the radioactive crud) requires a different treatment process (with both filtration and activated carbon adsorption steps) to those used in the HCW and LCW systems. In this case, after appropriate monitoring to ensure that residual activity levels are ALARP, the treated water is discharged to the environment through a permitted route.

A fourth subsystem, the CAD subsystem, is used to collect waste water from other plant and systems in the radiologically controlled areas (RCAs) in the Reactor Building (R/B) and Turbine Building (T/B). The waste water collected from the RCAs is potentially contaminated. This water is simply sampled to confirm it contains no significant radiological contamination (or unacceptable chemical contamination) before it is discharged to the environment. If the water is found to contain any significant radiological contamination or unacceptable chemical contamination, then the operator can route the water for treatment using the HCW subsystem. The parameters used to assess whether a liquid is to be treated using the HCW system will be defined and shared with the regulators in due course.

The radioactive materials removed from the waste water streams treated by the HCW and LCW subsystems are collected and contained in the form of wet sludges, used ion exchange resins. These wet-solid wastes are stored in tanks within the radioactive waste building before being transferred to the solid radioactive waste treatment facilities where they are processed into a passively safe state (these facilities are currently at a concept design stage, see Section 18.4 below). Used activated carbon from the LD subsystem, is dewatered and placed into drums which are then transferred for processing in the Solid LLW Facility (this facility is currently at a concept design stage, see Section 18.4.3.3 below).

The Rw/B also includes storage tanks for wet solid wastes (crud, sludges and spent resins) generated during the polishing of condensate water in the T/B and reactor and Fuel Pool water clean-up in the R/B. The wastes are either transferred directly to the radioactive waste building storage tanks or are first collected in backwash receiver tanks in the turbine or reactor buildings before being transferred to the radioactive waste building storage tanks. These wastes are also periodically transferred to the solid radioactive waste treatment facilities (these facilities are currently at a concept design stage, see Section 18.4 below) for treatment e.g. cementation or incineration. Indicative routes will be selected following a decision making process within GDA and the final waste route selection will be made.

The various tanks within the LWMS are vented and connected to a heating, ventilating and air conditioning (HVAC) system in RW/B. This will result in gaseous discharges being associated with the LWMS.

18.2.2 Design Basis

The LWMS does not provide a reactor safety function and is not required for safe shutdown of the reactor. However, the LWMS handles and processes radioactive liquids and the safety function in this respect is to ensure that discharges to the environment and any radiation doses to the public or operators are ALARP.

18.2.2.1 Safety Requirement

This section summarises the nuclear safety requirement for the liquid radioactive waste processing and storage systems for the UK ABWR design. The UK ABWR has been designed to minimise the liquid radioactive waste activity levels and waste volumes during operation. The LWMS ensures safe:

- Segregation at source and collection of the various waste water streams resulting from UK ABWR reactor and turbine operations
- Treatment of waste water to allow safe discharge to the environment

18.2.2.1.1 Normal Operation

Doses to both the operators and the public from normal operation of the UK ABWR Liquid Radioactive Waste Management system are ALARP. The dose assessment given in [Ref-1] calculates an overall indicative annual exposure of a member of the public resulting from liquid discharges during normal operation of a single UK ABWR unit to be approximately 0.15 μSv/y.

Doses to the Public

The design of the LWMS ensures that:

- Direct radiation to the most exposed member of the public resulting from normal operation of the Liquid Radioactive Waste Management system is ALARP. The combination of the shielding provided by radioactive waste building structures and the distance of the radioactive waste facilities from the generic site boundary results in ALARP doses to the public due to direct radiation in normal operation.

- Doses to the public from radioactive liquid discharges to the environment are optimised through the use of Best Available Techniques (BAT). A representative sample of waste water is taken prior to any discharge to measure residual activity levels and check that they are within set limits and ALARP.
- Doses to the public from gaseous discharges to the environment are optimised through the use of BAT. e.g. exhaust gases from HVAC systems are suitably filtered prior to final discharge to atmosphere. Levels of activity in filtered gaseous discharges are monitored allowing operators to take corrective action in the event that activity levels exceed set levels.

Doses to Workers

The design of the LWMS ensures that:

- Appropriate shielding is provided for operators against direct radiation in line with approach/principles described in [PCSR Ch.20 Radiation Protection] such that doses will be ALARP.
- Radiological protection measures for workers are provided in line with the principles described in [PCSR Ch.20 Radiation Protection] such that doses will be optimised.
- Rw/B layouts and HVAC systems are designed to ensure air flows from areas of no/low contamination to areas with potentially higher levels of contamination.
- The liquid radioactive waste system/equipment is designed so that doses to workers during maintenance (including recovery from plant breakdowns) are ALARP.
- The LWMS includes engineered flushing points which so far as is reasonably practicable (SFAIRP) enable any settled radioactive contamination to be flushed from the system prior to maintenance work being carried out thus ensuring operator doses during maintenance are ALARP.

General

The liquid radioactive wastes are contained and controlled within appropriately engineered facilities (see Section 18.2.2.4 below). In addition appropriate monitoring, measuring and sampling equipment is provided so that operators can check and record that wastes coming into and being dispatched from the facility are as expected.

18.2.2.1.2 Faults

Potential Doses to the Public in Faults

The design of the LWMS ensures that doses to public in faults are ALARP and within limits/targets given in [PCSR Ch.5.3]. The LWMS design has been assessed to identify all credible failure modes/fault conditions with the potential to lead to an off-site radiological release (the design basis). Where appropriate, the design of the LWMS system includes automatic/engineered fault prevention, protection and mitigation features to ensure that the assessed fault consequences are both within the limits/targets specified in [PCSR Ch.5.3] and ALARP.

Natural Hazards

The radioactive waste system civil structures/building envelopes etc. are designed and qualified to appropriate standards and provide protection against the following natural events:

- Earthquake
- High Wind
- Flooding
- Extreme temperature

- Snow loading
- Other external hazards as appropriate.

Fire/explosion

The overall design and layout of the radwaste building is compliant with the relevant UK fire regulations. In the unlikely event that a significant fire/explosion did result in damage to the radwaste building and a consequential radiological release, then even on a bounding conservative assessment the consequential off site dose to the most exposed member of the public would be less than the limits identified in [PCSR Ch.5.3].

Internal Flooding

The overall design and layout of the radwaste building is such that in the unlikely event that internal flooding did result in damage to the LWMS and a consequential radiological release, then even on a bounding conservative assessment the consequential off site dose to the most exposed member of the public would be less than the limits identified in [PCSR Ch.5.3].

Missiles

The overall design and layout of the radwaste building is such that in the unlikely event that an internally generated missile did result in damage to the LWMS and a consequential radiological release, then even on a bounding conservative assessment the consequential off site dose to the most exposed member of the public would be less than the limits identified in [PCSR Ch.5.3].

Potential Doses to Operators in Faults

Potential doses to operators in faults are ALARP, including potential doses associated with post-fault operator actions required to secure affected plant in a safe condition. Where appropriate the design includes specific engineered provisions to facilitate identified fault recovery actions by the operators.

18.2.2.2 Functional Requirement

The LWMS provides sufficient capacity to handle liquid wastes for normal operation, start-up, shut-down, and outages. In the event of a fault condition which resulted in excessive leakage of water into the R/B or T/B sumps, the operators would isolate the sump pumps on receipt of high leakage rate alarm. In the event of a LOCA signal all dry well sump pumps are automatically isolated.

The LWMS also includes temporary storage tanks for secondary wet-solid wastes generated by the above liquid waste processing systems. The LWMS may be used on a case by case basis for treating waste generated as a result of an accident.

18.2.2.3 Design Related Requirement

Categorisation and classification of structures, systems and components are decided based on fault studies.

Seismic category is decided based on fault studies.

18.2.2.4 Design Criteria

The construction and design of the LWMS buildings and processing equipment (pipes, tanks, sumps etc.) have used appropriate engineering design principles and are engineered to the required withstands (pressure, seismic etc.). Material selection is based on corrosion resistance and operating conditions. The equipment is designed in accordance with ISO, BS and European Standards and the following general design features are also included:

- Tanks, pipes, pumps etc. in the LWMS use appropriate materials, are designed against appropriate design temperatures and pressures and are manufactured and tested in accordance with UK engineering standards.
- Except where break-in requirements for maintenance or recovery from breakdowns, the LWMS are fully welded systems.
- Measures will be taken, so far as is reasonably practicable, to minimise leakages from pipework transferring radioactive effluents that are embedded in floors or walls.
- The LWMS control system includes monitoring of all the main process parameters (pressure, flow, temperature, tank levels, etc.) with appropriate alarms provided to the operators in the event of abnormal conditions.
- The LWMS control system includes level control for all tanks including appropriate interlocks to prevent tank overflows.
- Notwithstanding the above, all LWMS tanks have engineered overflow routes to alarmed sumps where appropriate.
- Bunding will be provided in line with UK regulatory requirements and industry relevant good practice, including all tanks and, where appropriate, any other piece of equipment containing liquids.
- All floor drainage and bunding sumps include leak detectors/alarms and pumps to recover any spilt liquids into the LWMS.
- Bunding is provided at all external doors to LWMS buildings to prevent the spread of any spilt liquids to the outside of the buildings.
- Appropriate shielding, radiological protection and other provisions (e.g. the inclusion of engineered flushing points) to minimise operator doses during normal operation and during examination, inspection, maintenance and testing of equipment.

18.2.3 System Description

The LWMS is housed in the Rw/B and S/B, and consists of the following four subsystems:
- Low Conductivity Waste subsystem
- High Conductivity Waste subsystem
- Laundry Drain subsystem
- Controlled Area Drain subsystem

In addition to these four subsystems (which are described in Sections 18.2.3.2 to 18.2.3.5 below), there are also number of storage tanks that are used to temporarily store the secondary wet-solid wastes generated by both LWMS treatment systems and the main primary circuit water treatment systems in the R/B and T/B (see Section18.2.3.6 below). Also, to give a more complete picture so as to aid understanding, a fifth (interfacing) subsystem, the Radioactive Drain Transfer System (RD), is also described in Section 18.2.3.1 below. However the RD subsystem also sits inside the R/B and its safety case is provided in PCSR Chapter 16 Auxiliary System.

18.2.3.1 Radioactive Drain Transfer System

This system is used to transfer waste water collected in the controlled areas in the R/B, T/B and S/B into collection tanks in individual LWMS subsystems installed in the Rw/B. The RD subsystem comprises sump tanks, sump pumps, piping, valves, and appropriate instrumentation. In general, waste water is segregated and collected at source as follows.

- Equipment Drains – collect radioactive or potentially radioactive waste water from Primary Circuit system and equipment in the R/B and T/B, from Fuel Pool system and equipment, and also from system and equipment in the Rw/B. This waste water is generally expected to have low levels of impurities and, therefore, is normally automatically pumped from the equipment drain sumps to the LCW subsystem Collection Tank. Note, however, that for certain plant areas the operator can select whether the waste water is routed to the LCW or HCW subsystem, depending on the level of impurities it is expected to contain. Individual sumps and the associated pumps are sized to handle the expected waste water volumes from the equipment they serve.
- Floor Drains – collect waste water spillages in each separate area of the R/B, T/B and Rw/B. The water quality in terms of suspended solid concentration is relatively clean. As the quality of the water is suitable to be treated by LCW, the drains collected in Drain Sumps are automatically pumped to LCW. Individual floor drain sumps and the associated pumps are sized to handle any water spillages on the floor areas that might occur during normal operation, start-up, shut-down and outages.
- Chemical Drains- collect the chemical waste generated at the laboratory in S/B and collect high conductivity water such as the condensate demineraliser drains. The chemical drain generated at the laboratory is collected into the Drain Sump and is automatically pumped to HCW. Drain from the condensate demineraliser is collected into the HCW collection tanks.
- Laundry Drains - collect waste water from the laundry and from the personnel shower and hand washing facilities. This waste water is automatically transferred to the Laundry Drain Collection Tanks. The Laundry Drain waste water steam includes detergents and organic materials and is kept separate from the other waste water streams because it has to be treated using a different process train (see Section 18.2.3.4).
- Controlled Area Drains - collect waste water from other systems (e.g. local HVAC systems) in the RCAs in the Reactor Building and Turbine Building. The waste water collected from the RCAs is potentially contaminated. This water is automatically transferred to the Controlled Area Drains Collection Tank (see Section 18.2.3.5 for further details).

18.2.3.2 Low Conductivity Subsystem

The LCW subsystem (see Figure 18.2-1) is housed in the Rw/B and is one of two subsystems (the other being the HCW subsystem) which are used to treat radioactively or potentially radioactively contaminated waste water, the main sources of which are the reactor primary coolant system, Fuel Pool Clean Up system (FPC) and plant make up water system. The LCW system is designed to allow the efficient treatment of relatively large volumes of waste water containing low levels of both insoluble and soluble impurities (and hence of low conductivity). Before treatment, a sample of the waste is analysed to confirm properties (e.g. conductivity) of waste. If waste properties are not suitable for treatment in LCW system, these wastes are transferred to HCW system. Simple hollow fibre membrane filters are used to remove the insoluble impurities (with back pulse cleaning of the filter membrane upon detection of a raised differential pressure). The filtered water is then passed through a mixed bed demineraliser packed with bead ion exchange resins to remove soluble impurities.

Treated water is collected in a sample tank, where a representative sample of the water is analysed to confirm it meets the criteria for re-use in the reactor. If the treated water does not meet the appropriate criteria, it can be routed back to the LCW Collection Tank and the treatment process repeated (potentially multiple times) until the criteria are met. Once the treated water has been confirmed to meet the appropriate criteria it is normally sent to the Condensate Storage Tank (CST) for reuse as reactor Primary Circuit or Fuel Pool make-up water.

18.2.3.2.1 Capacity

The LCW subsystem is designed to process the following (maximum) daily volumes of waste water:

Table 18.2-1 : Quantity of LCW

Type	Quantity (m^3/day)		
	Normal (m^3/day)	Maximum (m^3/day)	Maximum at LWMS (partial) outage (m^3/day)
Equipment drain	63	443	187
Floor drain	1	3	6.5
Total LCW	**64**	**446**	**193.5**

Number and capacity of major equipment (pools and processing equipment) in LCW system are as follows:

Table 18.2-2 : Number and Capacity of Major Equipment in LCW System

Equipment	Number (unit)	Capacity (per unit)
LCW Collection Pool	2	330 m^3
LCW Filter	2	15 m^3/h
LCW Demineraliser	2	15 m^3/h
LCW Sample Pool	2	330 m^3

18.2.3.3 High Conductivity Subsystem

The HCW subsystem (see Figure 18.2-1) is also located in the Rw/B and is the second subsystem used for the treatment of radioactively or potentially radioactively contaminated waste water. The HCW subsystem includes an initial distillation step to allow the efficient treatment of waste water with relatively high levels of soluble and insoluble impurities (and hence with a high conductivity), principally waste water collected by the chemical analysis lab (hot lab) drains and condensate demineraliser drains. The waste water received by the HCW subsystem is first subjected to evaporative concentration (distillation). At a predefined point in the distillation process, the evaporator bottom drain is discharged to the Concentrated Waste Storage Tanks in batches. (The concentrated liquid waste stored in these tanks is subsequently transferred for treatment in the Solid Waste Management System, these facilities are currently at a concept design stage, see Section 18.4 below). The distillate is collected in the HCW Distilled Water tank and then passes through a demineraliser (mixed bed demineraliser packed with a bead ion exchange resin) to remove any soluble contaminants that could potentially be carried over from the concentrator. Treated water is collected in a sample tank, where a representative sample of the water is analysed to confirm it meets the criteria for re-use in the reactor (or for discharge to the environment). If the treated water does not meet the appropriate criteria, it can be routed back to the HCW Collection Tank and the treatment process repeated (potentially multiple times) until the criteria are met. Once the treated water has been confirmed to meet the appropriate criteria, it is normally sent to the Condensate Storage Tank (CST) for reuse as reactor Primary Circuit or Fuel Pool make-up water. Only when the treated water volumes exceed Primary Circuit and Fuel Pool water make-up requirements, is the treated water discharged to the environment. On these occasions the treated water is first monitored to ensure that residual levels of contamination are within set discharge limits and ALARP.

18.2.3.3.1 Capacity

The HCW subsystem is designed to process the following (maximum) daily volumes of waste water:

Table 18.2-3 : Quantity of HCW

Type	Quantity (m^3/day)		
	Normal (m^3/day)	Maximum (m^3/day)	Maximum at LWMS (partial) outage (m^3/day)
Floor Drain	0	4	5.5
Chemical Drain	3	43	3
Total HCW	**3**	**47**	**8.5**

Number and capacity of major equipment (tanks and processing equipment) in HCW system are as follows:

Table 18.2-4 : Number and Capacity of Major Equipment in HCW System

Equipment	Number (unit)	Capacity (per unit)
HCW Collection Tank	2	60 m^3
HCW Evaporator	2	1.5 m^3/h
HCW Demineraliser	1	3 m^3/h
HCW Sample Tank	2	60 m^3

.

18.2.3.4 Laundry Drain Subsystem

The LD subsystem (see Figure 18.2-1) processes waste water originating from the laundry and the personnel showers and hand washing facilities. These waste water streams contain detergent, suspended solids and organic material, as well as potentially low levels of radioactive crud. To remove these impurities the water is first passed through a packed bed pre-filter, then an activated charcoal adsorption unit. The packed bed filter traps relatively large-size suspended solids, which are removed from the system as waste sludge together with the filter media, which are emptied into 200 litre drums. The activated charcoal adsorption unit adsorbs organic impurities on activated charcoal and traps relatively small-size suspended solids. The adsorbed impurities and the suspended solid are removed from the system together with the (exhausted) activated carbon, which is first dewatered and then emptied into 200 litre drums. The 200 litre drums containing the secondary wastes from processing system are transferred to the Wet LLW Treatment Facility (this facility is currently at a concept design stage, see Section 18.4.3.3 below). The treated water is collected in a sample tank, where a representative sample of the water is analysed to confirm that the residual level of radioactive contamination is ALARP and meets the criteria for discharge to the environment. If the treated water does not meet the discharge criteria, it can be routed back to the Laundry Drains Collection Tank and the treatment process repeated (potentially multiple times) until the discharge criteria are met.

18.2.3.4.1 Capacity

The LD subsystem is designed to process the following maximum daily volumes:

Table 18.2-5 : Quantities of LD and HSD

Type	Quantity (m^3/day)	
	Normal (m^3/day)	Maximum (m^3/day)
Laundry Drain	3	21
Hot Shower Drain	2	14
Total LD and HSD	**5**	**35**

Number and capacity of major equipment (tanks and processing equipment) in LD system are as follows:

Table 18.2-6 : Number and Capacity of Major Equipment in LD System

Equipment	Number (unit)	Capacity (per unit)
LD Collection Tank	2	30 m^3
LD Pre-filter	2	1 m^3/h
LD Activated Carbon Adsorption Tower	2	1 m^3/h
LD Filter	2	1 m^3/h
LD Sample Tank	2	30 m^3

18.2.3.5 Controlled Area Drains Subsystem

The CAD subsystem (see Figure 18.2-1) collects the drains of the local air-conditioning systems in the R/B and T/B, and also the potentially contaminated drains from various equipment systems in the controlled areas of the R/B and the T/B.

The collected water is pumped to the Controlled Area Drains Collection Tank where it is sampled to confirm it contains no significant radiological contamination (or unacceptable chemical contamination) before it is discharged to the environment. If the water is found to contain any significant radiological contamination or unacceptable chemical contamination, then the operator routes the water for treatment using the HCW subsystem (see Section 18.2.3.3 above).

18.2.3.5.1 Capacity

The CAD subsystem is designed to process the following (maximum) daily volumes:

Table 18.2-7 : Quantity of CAD

Type	Quantity (m^3/day)	
	Normal (m^3/day)	Maximum (m^3/day)
Condensate water of local coolant	3	4

Coolant water blow	0	30
Total CAD	**3**	**34**

Number and capacity of major equipment (tanks) in CAD system are as follows:

Table 18.2-8 : Number and Capacity of Major Equipment in CAD System

Equipment	Number (unit)	Capacity (per unit)
CAD Collection Tank	2	30 m^3

18.2.3.6 Waste Water Treatment Secondary Waste Storage

The water treatment subsystems generate their own secondary wastes. These secondary wastes are temporarily stored in tanks before being transferred to the Solid Waste Management System (these facilities are currently at a concept design stage, see Figure 18.2-3) for processing and conditioning in preparation for either disposal off site (in the case of LLW), or for transfer to the interim on site storage facility (in the case of ILW).

- Spent bead (ion exchange) resins from the LCW and HCW subsystems
- Sludge and hollow fibre filters from the LCW subsystem
- Concentrated liquid waste from the HCW subsystem
- Sludge and packed bed filter media from the Laundry Drain subsystem
- Activated carbon from the Laundry Drain subsystem.

The spent bead resins from the LCW and HCW subsystems are pumped using motive water to one of the Spent Resin Storage Tanks, where they are temporarily stored pending transfer to the Solid Waste Management System facilities.

The sludge from the LCW subsystem is backwashed and pumped as sludge to the Sludge Storage tank, where it is temporarily stored pending transfer to the Solid Waste Management System facilities. The concentrated liquid waste from the HCW system is drained into the Concentrated Waste Storage Tanks, where it is again temporarily stored pending transfer to the Solid Waste Management System facilities. The concentrated waste has high solid concentration but the radioactive concentration is relatively low.

The three secondary LLW streams from the Laundry Drains subsystem are removed directly from the system into 200 litre drums, which are then transferred to the Solid LLW and Wet Solid LLW treatment Facilities (these facilities are currently at a concept design stage, see Sections 18.4.3.1 and 18.4.3.3 below).

In addition to the secondary wastes generated by the LWMS subsystems, wet-solid wastes are also generated by the main primary circuit water treatment systems in the R/B and T/B. Specifically these wastes are powder resins from the Reactor Clean-up System (CUW) and Fuel Pool Cooling Clean-up system (FPC) in the R/B, and Condensate Filter crud and bead resin from the Condensate Demineraliser (CD) in the T/B (see Figures 18.2-2 and 18.2-3). All of these wastes except bead resin from CD are backwashed into receiver tanks and then pumped across to the Sludge Storage tanks in the Rw/B, where they are temporarily stored pending transfer to the Solid Waste Management System facilities. The bead resin from the CD is backwashed from the demineraliser directly to the Spent Resin Storage Tanks in the Rw/B.

18.2.3.6.1 Capacity

The LWMS also includes temporary storage tanks for secondary wet-solid wastes generated by the above liquid waste processing systems. Number and capacity of CF/LCW Sludge Storage Tank, CUW/FPC Sludge Storage Tank, Spent Resin Storage Tank and Concentrated Waste Tank are as follows:

Table 18.2-9 : Number and Capacity of Storage Tanks for Secondary Wet-solid Wastes

Equipment	Number (unit)	Capacity (per unit)
CF/LCW Sludge Storage Tank	2	120 m^3
CUW/FPC Sludge Storage Tank	2	70 m^3
Spent Resin Storage Tank	2	120 m^3
Concentrated Waste Tank	2	10 m^3

The volumes of these wet-solid wastes arising are given in [Ref-2].

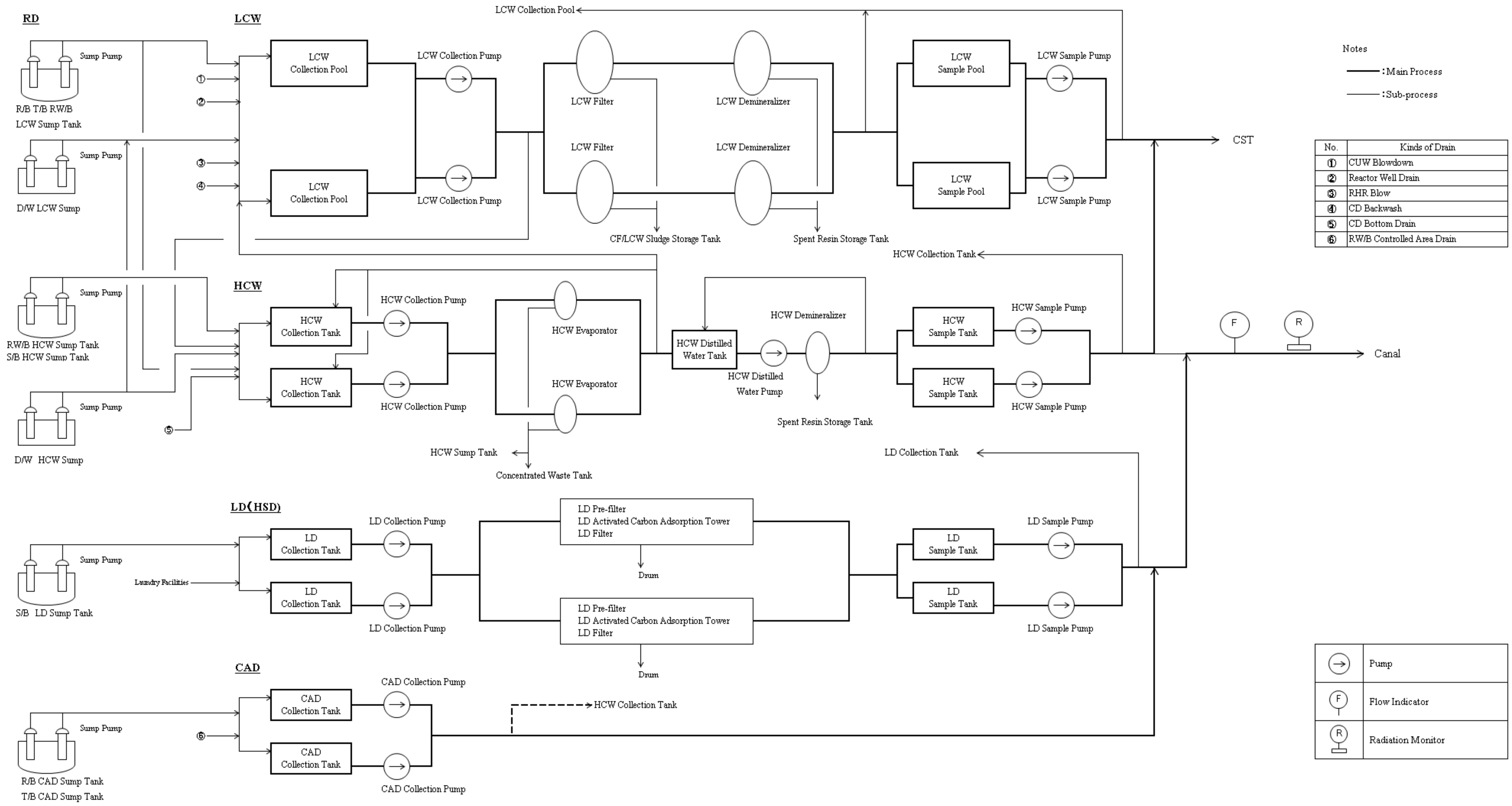

Figure 18.2-1 : Liquid Radwaste System Flow

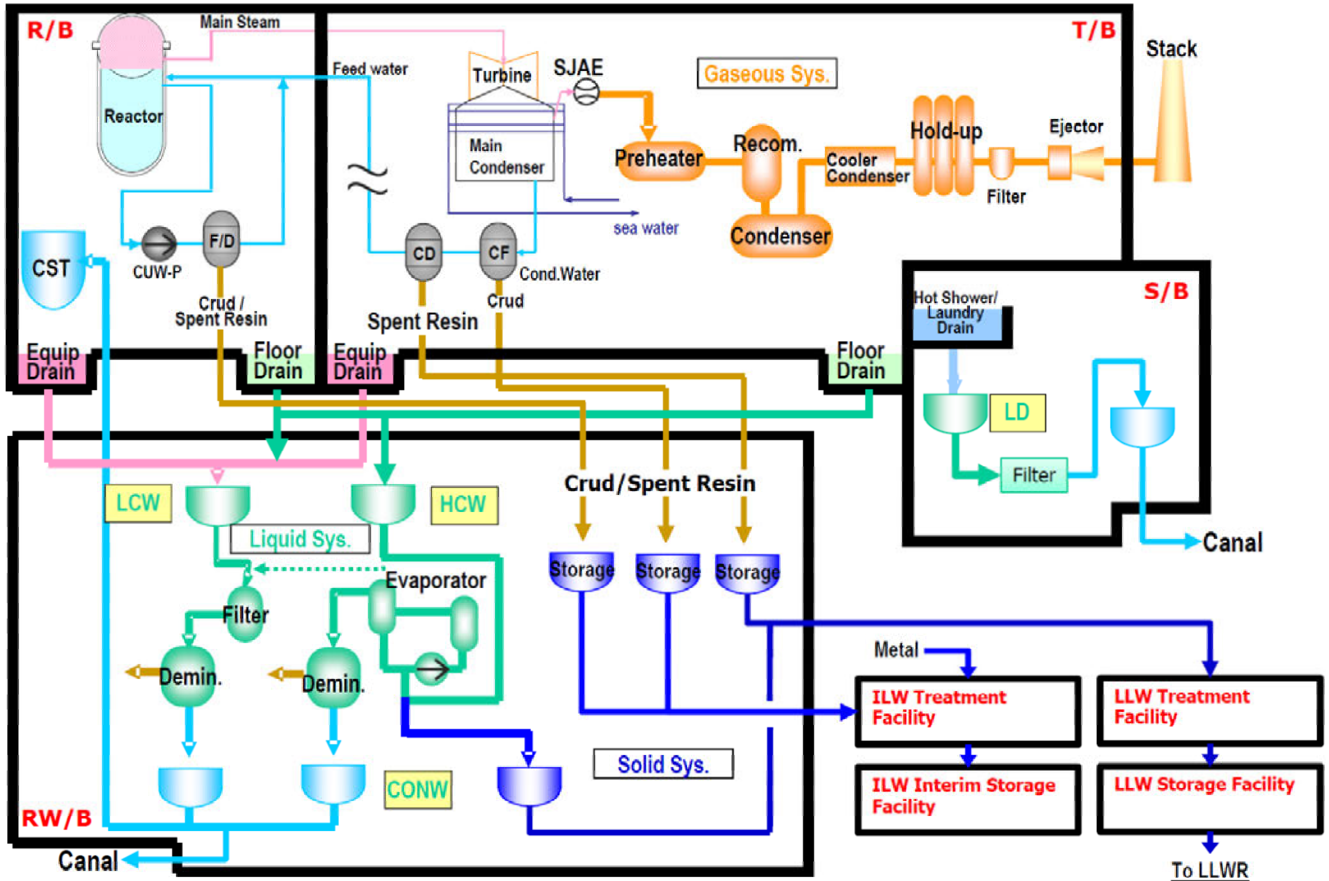

Figure 18.2-2 : Radwaste Treatment System Overview

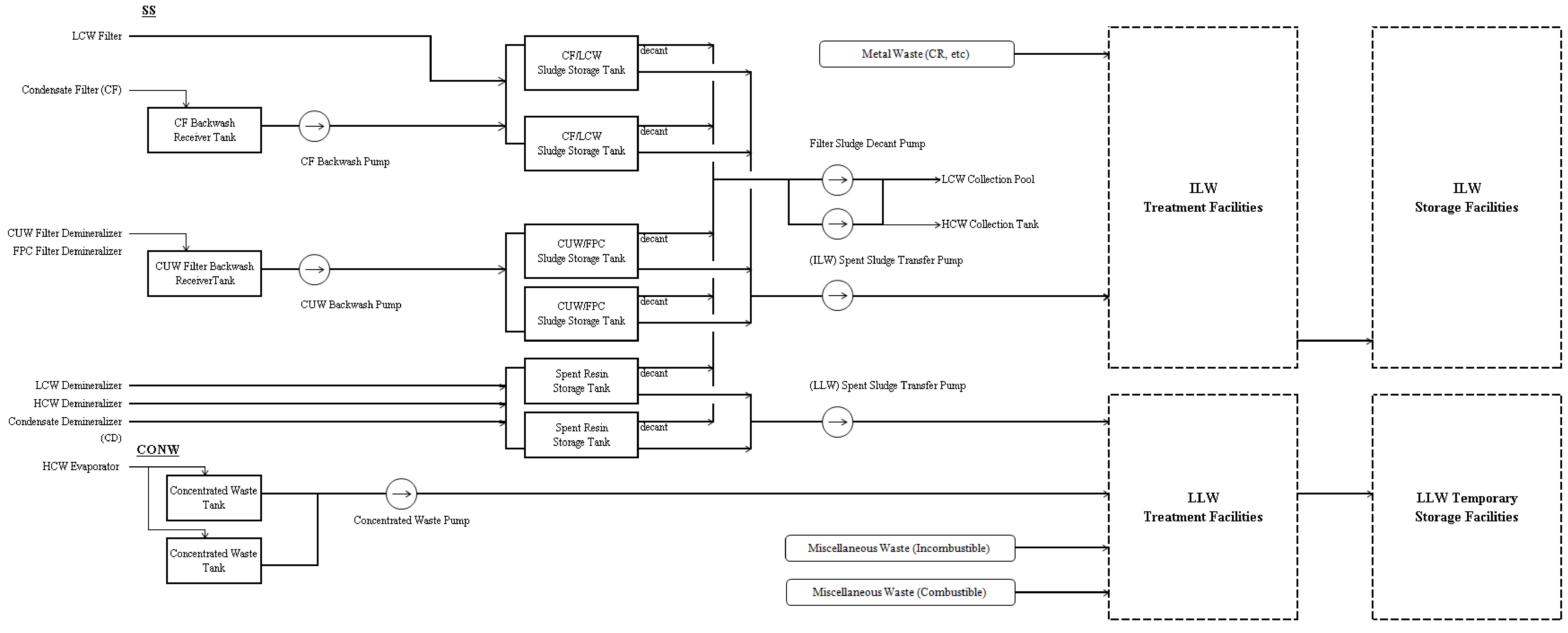

Figure 18.2-3 : Wet-Solid System Flow

18.2.4 References

[Ref-1] "Quantification of Discharge and Limits" (GA91-9901-0025-00001; HE-GD-0004, Rev. D)
[Ref-2] "Radioactive Waste Management Arrangements" (GA91-9901-0022-00001; WE-GD-0001, Rev. D)