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KORC	ACCESS	IMPORTANCE CATEGORY	NEXT REVIEW DATE	DATE AUTHORISED
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DATE 2022-02-18	**DATE** 2022-02-25	**DATE** 2022-02-28

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CATEGORY 3 – PROCEDURE FOR REFERENCE

FCA	ALARA REVIEW	SUPERSEDES
PROTECTION	YES 2021-10-26	KWH-S-047, Rev 12 dd. 2021-06-09 PARTIAL REVIEW

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1.0 PURPOSE

1.1 To describe the practical implementation of radioactive material and radwaste control.

2.0 SCOPE

2.1 Applicable to:

2.1.1 The classification of radioactive waste into the different categories.

2.1.2 The manner in which packages of radioactive material are contained and wrapped.

2.1.3 Release and transfer of equipment and material.

3.0 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

3.1.1 **Artificial Nuclide** – Artificial radioactive isotopes are formed when an atom is bombed with an accelerator or exposing it to slow moving neutrons in a nuclear reactor. In this way isotopes (radionuclides) are obtained which are non-existent in nature because of their unstability and radioactive transition into stable isotopes.

3.1.2 **Baseline Count** – A radiological survey performed as the initial assessment of radiological conditions of a container and/or equipment including dose rates and contamination levels.

3.1.3 **Compactable Waste** – Consists of paper, disposable and disposed protective clothing, cleaning materials, plastic. No solid item e.g. wood or metal will be regarded as compactable.

3.1.4 **Dual Containment** – Is the use of secondary packaging for the transport and storage of radioactive material on site. The secondary packaging can be in the form of a second bag, wrapping, watertight container, drum container, rigid polythene or fibreglass container, or an approved shipping container. The primary package can be any of the different materials described under Packaging.

3.1.5 **Equipment** – Is referred to as, but not limited to the following examples: Potential Contaminated Material, Components and Chemistry Samples.

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3.1.6 **Freight Container** – Shall mean a receptacle of transport equipment designed to facilitate the transport of goods, either packaged or unpackaged, by one or more modes of transport without intermediate reloading which is of a permanent enclosed character, rigid and strong enough for repeated use, and must be fitted with devices facilitating its handling, particularly in transfer between conveyances and from one mode of transport to another. A small freight container (3m) is that which has either any overall outer dimension less than 1.5m, or an internal volume of not more than $3m^3$. Any other freight container is considered to be a large freight container.

3.1.7 **Licensed Radionuclides** – Radionuclides listed in table T-II-5.2-1 of the Safety Analysis Report (SAR) Rev 4. See Appendix 2

3.1.8 **Non-compactable Waste** – Consists of solid items such as wood, metal pieces, parts of equipment, redundant plant, and empty containers.

3.1.9 **Packaging** – Is used to contain contamination by using bags, wrapping, watertight containers, rigid polythene or fibreglass liners or containers, or an approved shipping container.

3.1.10 **Radioactive Material** – Is any material with surface contamination that exceeds the limit specified in 238-36 for tools and equipment or any volume contaminated material with specific activity levels exceeding those specified in 238-54.

3.1.11 **Representative Sample** – A representative sample will be one where the contents has been sufficiently mixed mechanically in order to ensure proper distribution of any activity within the bulk of the liquid, including precipitated activity on the bottom of the container.

3.1.12 **Transfer Container** – Is a sealed metal structure of various dimensions used to facilitate the transfer of various equipment or materials between Controlled Zone on site or packed into a larger container i.e. Freight Container.

3.1.13 **Unlicensed Radionuclides** – Radionuclides not listed in table T-II-5.2-1 of the Safety Analysis Report (SAR) Rev 4.

3.1.14 **Volume Contaminated Material** – Contains a limited amount of specific activity distributed throughout the volume of the material. The material can be either solid or liquid.

3.1.15 **WearCheck** – Is a process where a sample of oil is used to determine component wear.

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3.2 Abbreviations

3.2.1 **ALARA** – As Low as Reasonably Achievable

3.2.2 **cpm** – counts per minute

3.2.3 **cps** – counts per second

3.2.4 **CRONOS-4** – Small Items Monitor

3.2.5 **CSB** – Cask Storage Building

3.2.6 **CZ** – Controlled Zone

3.2.7 **DWS** – Decontamination Work Shop

3.2.8 **EPD** – Electronic Personal Dosemeter

3.2.9 **IAEA** – International Atomic Energy Agency

3.2.10 **ISI** – In Service Building

3.2.11 **ISOCS** – In Situ Object Counting System

3.2.12 **KRT** – Plant Radiation Monitoring System

3.2.13 **L-177** – Ludlum 177 Frisking Instrument

3.2.14 **LLW** – Low Level Waste

3.2.15 **MDA** – Minimum Detectable Activity

3.2.16 **NAB** – Nuclear Auxiliary Building

3.2.17 **NCW** – Non Compactable Waste

3.2.18 **NNR** – National Nuclear Regulator

3.2.19 **PPE** – Personal Protective Equipment

3.2.20 **PVC** – Polyvinyl Chloride Plastic

3.2.21 **Radeye Sx** – Radeye Frisking Instrument

3.2.22 **RadPro** – Radiation Protection Computer Database System

3.2.23 **RP** – Radiation Protection

3.2.24 **RPC** – Radiation Protection Certificate

3.2.25 **RPM** – Radiation Protection Monitor

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3.2.26 **RPOO** – Radiation Protection Operations Office

3.2.27 **SOP** – Step Off Pad

3.2.28 **SRPA** – Senior Radiation Protection Assistant

3.2.29 **TLD** – Thermoluminescent Dosemeter

4.0 REFERENCES

4.1 Referenced Documents

4.1.1 238-34, Rev 0b: Optimisation of Radiation Protection

4.1.2 335-2, Rev 5: Koeberg Nuclear Power Station Management Manual

4.1.3 IAEA TS-R-1: Regulations for the Safe Transport of Radioactive Material

4.1.4 KAA-500, Rev 13: The Process for Controlled Documents

4.1.5 KSA-011, Rev 14: The Requirements for Controlled Documents

4.1.6 KWH-I-091, Rev 5a: Operation, Use and Calibration of the Cronos-4 R

4.2 Applicable Documents

4.2.1 238-36: Operational Radiation Protection Requirements

4.2.2 238-54: Radiological Protection Licensing Requirements for Koeberg Nuclear Power Station

4.2.3 EPRI Report 1019224: Radioactive Material Monitoring and Control Guideline

4.2.4 KAA-634: Responsibilities for the Radioactive Material and Radioactive Waste Control Programme

4.2.5 KAH-002: Radiation Surveillance Programme

4.2.6 KFH-HP-187: Portable Instrument Bulk Release

4.2.7 KFH-HP-189: Unconditional Clearance Checklist

4.2.8 KSH-008: Radiation Protection Records, Data and Information Management

4.2.9 KWH-I-074: Gamma Spectrometry with Genie 2000 and ISOCS

4.2.10 KWH-S-001: Radiation and Surface Contamination Surveys

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4.2.11 KWH-S-037: Classification of Solid Radioactive Materials and the Acceptable On and Off-site Packaging Requirements for such Materials

4.2.12 KWH-S-048: Signposting and Barricading in Radiological Controlled Zones

4.2.13 SAR: Safety Analysis Report Chapter 5 Part II

4.2.14 TR-004/12: Process for Release of Volume Contaminated Materials from RP Controls using Isotopic Analysis Results

5.0 PREREQUISITES

5.1 A maximum volume of 3m³ is permissible per annum for release of oil containing artificial nuclides.

6.0 PRECAUTIONS AND LIMITATIONS

6.1 Care must be taken when using cling wrap to ensure proper coverage of equipment. Use at least two layers.

6.2 Radioactive material located and originating in areas having a radiological hazard are identified as part of the surveillance programme and signposted / barricaded as per KWH-S-001 radiological and/or contamination zone classification.

NOTE: *Any area or room outside the current radiological control zones i.e. NAB, Fuel Buildings, PTR tank rooms, Containment buildings, ISI, DWS, Chemistry, CSB, LLW and LLW yard, may be established to store radioactive material with the approval of the RP Manager or authorised designate and signposted / barricaded as per KWH-S-001 radiological and or contamination zone classification.*

6.3 The Unconditional Clearance Checklist (KFH-HP-189) shall be used for each item, or batch of items unconditionally released from any controlled zone.

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7.0 PROCEDURE

7.1 Identification

7.1.1 Radioactive material is identified by using appropriate measuring equipment.

7.2 Equipment Surveys

7.2.1 General Requirements

7.2.1.1 Direct contamination surveys may be used to determine equipment contamination levels. Refer to KWH-S-001

7.2.1.2 Surveys of equipment for clearance or transfer must be performed in a controlled zone, or a temporary controlled zone, unless conditionally released for final clearance in a low background area.

7.2.1.3 If contamination exceeding the applicable limits are found, go over the area with the probe to find the boundaries of contamination. Determine whether it is loose contamination by taking a smear across the contaminated area.

7.2.1.4 For large surfaces it is preferable to use a large area probe to identify the contaminated area, and then use a small area probe to quantify the contamination levels.

7.2.1.5 If internal surfaces cannot be reached, the equipment shall be opened by personnel authorised to do so, alternatively appropriate analysis of internal surfaces shall be used, for example ISOCS.

7.2.1.6 Wet equipment shall not be released. The self-shielding of radiation by the water will result in reduced efficiency and erroneous results.

7.2.1.7 Liquids shall not be released unless a gamma spectroscopy analysis has been performed and the specific activity is below the criteria stipulated in Appendix 1.

NOTE 1: *This excludes Chemistry liquid samples surveyed by Chemistry that are transferred between Laboratories on site.*

NOTE 2: *Gamma spectroscopy analysis is required of samples, which originate from any controlled zone, before transfer to the ESL.*

7.2.1.8 Records shall be kept of all release surveys performed.

7.2.1.9 Records shall include a detailed description of the equipment and, where possible, survey points on the equipment.

7.2.1.10 Unconditional release surveys shall be performed at the discretion of the duty SRPA to ensure that adequate manpower can be provided to comply with all requirements.

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7.2.1.11 When there is any concern about the risk of releasing equipment, the equipment shall not be released.

7.2.1.12 Boundaries between Controlled and Non-controlled zones will be either:

- Locked and the key controlled by RP or;
- connected to a central alarm to warn of inadvertent opening or;
- manned by RP or;
- barricaded and appropriate instructions displayed, with approval from an SRPA.

7.2.2 Cronos-4 and ISOCS Release Surveys

7.2.2.1 The Cronos-4 shall be used for the release of equipment that can fit into the measuring chamber, weighs less than 100 kg (Cronos-4) and does not have significant self shielding materials that could mask activity, or is not allowed for monitoring, (e.g. magnets).

7.2.2.2 Equipment must be monitored as a whole. Breaking up of equipment into smaller parts is only allowed to identify contaminated subparts. All parts as a whole making up the piece of equipment shall still clear the Cronos-4.

7.2.2.3 Personal items of radworkers may be monitored in the Cronos-4 by the radworkers. These include pens, clipboards, headlamps, flashlights and PPE.

7.2.2.4 A baseline count of any material/equipment that must be monitored in the Cronos-4 for clearance and that may contain high levels of natural radioactive isotopes (e.g. camera lenses, batteries), should be monitored in the Cronos-4 before it is used in the controlled zone. This information can be compared to the count when the item is removed from the controlled zone again. A logbook should be kept at each Cronos-4 for this purpose, containing at least the following information:

- unique equipment description and owner contact details;
- baseline Cronos-4 readout;
- date (into the CZ);
- RP representative;
- Cronos-4 readout on exit;
- RP representative;
- Date (exit from CZ).

A variance of not more than 20% is allowed, due to the inherent uncertainty in measurements.

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7.2.2.5 Use ISOCS process as described in KAA-634 when:

- Equipment is too large and/or, internal surfaces cannot be surveyed using direct frisking or swipes.
- Equipment shape and size where manual surveys could result in human error or attention lapse must be cleared.

  ***NOTE**: Clearing items unconditionally using ISOCS.*

- Only items that are not volume contaminated may be cleared using ISOCS. This includes items that are contaminated on the surface such as wooden pallets, non-activated metal, plastic and rubber and cement that was not exposed to contaminated water that may have seeped into the matrix. It excludes liquids, absorbent material such as rags and other trash that makes up a matrix that cannot be regarded as surface contaminated.
- The limits for surface contamination will apply (0,4 Bq/cm^2). ISOCS must therefore be used to determine the activity per cm^2, and not per kg (sample information is edited for a surface area quantity and not mass). The method of performing the efficiency calibration remains unchanged.
- Since this limit is applicable to an averaged activity over 300 cm^2 (the basis being to ensure an even activity distribution over the surface area), an evenly distributed activity concentration (if present at all) must be ensured. This is done by following existing practice to decontaminate equipment first and then perform a surface contamination survey and only if no contamination is detected in accessible areas is it sent to ISOCS. The LACE application of ISOCS (refer 7.6 of KWH-I-074) can then be further used to determine an even distribution (a flat line indicates the assumption of an even activity distribution in the sample geometry is valid).
- The MDA value or, if identified, the activity concentration, must then be compared to the limit of 0,4 Bq/cm^2.

7.2.3 Manual Unconditional Release Surveys

7.2.3.1 The current doserate instruments do not provide adequately low contamination detection levels for clearance surveys therefore a contamination instrument must be used instead.

7.2.3.2 The appropriate survey meter and probe must be used for the type of contamination suspected to be on the equipment.

7.2.3.3 The RadEye Sx shall be the preferred frisking instrument used for direct manual release surveys due to the improved efficiency, larger probe size and longer response time. If using a RadEye Sx and is not practical or become unavailable, use the L-177 and indicate this in the Unconditional Clearance Checklist (KFH-HP-189) under special conditions.

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7.2.3.4 Frisking instruments shall always be used in the longest response time when performing release surveys. Refer to KWH-S-001 for method.

7.2.3.5 Non-contaminated material (unconditionally released) is collected at the Control Zone exit points and no further RP controls apply to the material.

7.2.3.6 The background shall be sufficiently low to enable surveys to be performed for unconditional releases. Appropriate background levels are indicated on the Unconditional Clearance Checklist, KFH-HP-189, for the L-177 and the RadEye Sx respectively.

7.2.3.7 All external surface areas shall be monitored for fixed and smearable contamination and all internal surfaces possibly exposed to contamination shall be monitored for fixed and smearable contamination.

7.2.3.8 Swipes shall be monitored in the Cronos-4 in addition to the monitoring by friskers. This will determine the gamma content.

7.2.3.9 Manual clearance surveys shall be documented on RadPro. Where RadPro does not make provision for the data required, the information shall be included in the comments section of the survey.

7.2.3.10 Any clearance survey performed by an RP Monitor shall be logged using the Unconditional Clearance Checklist (KFH-HP-189).

7.2.3.11 A peer check of manual clearance surveys must be performed. This will consist of an independent qualified RP person observing the clearance survey and verifying the following:

- the correct instrument;
- demonstrated the correct survey method;
- surveyed all applicable surface areas correctly;
- assessed the risks of unconditional release;
- assessed the need for gamma isotopic analysis (ISOCS);
- Completion of the unconditional release tags and Unconditional Clearance Checklist correctly.

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7.2.3.12 **Special Cases**

RP Portable Instruments

- RP portable instruments needing calibration or repair, shall be surveyed by a qualified RP person for unconditional clearance or conditional transfer to another control zone.

- An instrument utility person shall complete the Portable Instrument Bulk Release form (KFH-HP-187) for instruments that need calibration or repair.

- If no loose or fixed contamination is detected and the instrument clear via the Cronos, the instrument may be released unconditionally. Complete Unconditional Clearance Checklist (KFH-HP-189) and KFH-HP-187. Attached the unconditional clearance certificate to the completed KFH-HP-187 form.

- If the Cronos-4 alarms for an instrument or parts of it, once checked in the Cronos, the instrument may only be sent to the Calibration Lab if a manual frisk and smear survey indicate no detectable contamination on the external parts. Such instruments must be bagged, tagged with a transfer certificate and the completed Portable Instrument Bulk Release form attached to the transfer certificate. KFH-HP-187 must also indicate that there was a Cronos-4 alarm and the RP monitor must sign next to each instrument.

  NOTE 1: *Open lines must be deleted to prevent the addition of other instrument numbers.*

  NOTE 2: *SOP area to be set up at Cal. Lab. to open the instruments before instruments, that alarmed in the Cronos, are transferred to the Cal. Lab.*

- A survey shall be recorded on Radpro by the RP person who surveyed the instruments.

Chemistry Dewars

The Dewar used between the chemistry laboratory (chemistry building) and the liquid nitrogen tank, may be unconditionally cleared without the need for a peer check.

Portable Electrical Equipment

Drills, grinders, etc. must be opened to allow for the internal assessment of contamination levels before unconditionally clearing the equipment, using beta sensitive monitoring equipment or send to ISOCS for unconditional release.

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Portable Phones

May be cleared in the Cronos-4 by radworkers, provided it is kept in a plastic bag during entry to the Controlled Zone and plastic was removed before it is placed in the Cronos-4.

Headlamps

Headlamps are allowed to be worn on a person's hard hat when leaving through the portal monitors.

7.2.4 Equipment Surveys and Criteria for Transfer within or between Controlled Zones

7.2.4.1 Direct contamination surveys and swipes/smears should be used to determine equipment contamination levels.

7.2.4.2 If contamination by direct survey, exceed the applicable limits, is found above background > 200 cpm, or as practical at SOP (determined by ambient levels) survey the equipment by smear or swipe to determine whether it is loose contamination.

7.2.4.3 Demarcate and signpost equipment in accordance with procedure KAA-634 and KWH-S-048.

7.2.4.4 Surveys of equipment for transfer must be performed in a controlled zone, or a temporary controlled zone. Items for final clearance may be conditionally cleared for final clearance in a low background area refer to 7.2.3.6 above.

7.2.4.5 The Controlled Zone Equipment Tag provides adequate controls for the transfer of equipment, clothing and waste within the same controlled zone.

7.2.4.6 Radioactive material with low activity levels can be transferred under the general requirements of the RPC in force for the work being done, without any further special precautions or special RP cover.

7.2.4.7 The transfer of radioactive material with high activity levels requires specific RP precautions and RP cover. An ALARA review may also be required. The transfer will progress under the direction of the duty SRPA or day shift SRPA.

7.2.4.8 The affected control room must be notified before and after radioactive material with high activity levels is transferred within the NAB, Fuel buildings or containment, which could activate any KRT alarms.

7.2.4.9 The RP representative at the receiving facility must be notified whenever radioactive material with high activity levels will be transferred.

7.2.4.10 The shortest and safest possible route must be used for the transfer.

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7.2.4.11 The area where the radioactive material was loaded onto the transport vehicle must be surveyed after the radioactive material has been offloaded to ensure that no residual contamination is released.

7.2.4.12 The number of staff involved in the transfer must be kept to a minimum.

7.2.4.13 If freestanding liquid is suspected to be located inside components to be transferred, measures shall be taken to ensure it is contained to prevent spillage in any orientation of the component during handling and transportation. This will include sealing any openings that could contain contamination.

NOTE: *For transferring of transfer containers, USE TRANSFER CERTIFICATE/EQUIPMENT TAGS AND NOT TRANSFER OF CONTAINER CERTIFICATE.*

7.2.5 Transporting of Radioactive Liquids between Controlled Zones (Excluding Chemistry Samples)

7.2.5.1 Only use yellow coloured plastic drums that are clearly marked for use of radioactive liquid.

7.2.5.2 The number of drums used must be logged in a drum register together with the following information as a minimum:

- contents;
- where the drums will be used;
- who will be using the drums.

7.2.5.3 Each drum must be equipped with a lid including a metal clamp that can be properly closed to prevent spillages.

7.2.5.4 Each drum must be placed inside a red plastic bag in case the lid is not watertight.

7.2.5.5 Requirements for drum transport on the back of a light delivery vehicle (LDV):

- the back of the LDV must be covered in plastic;
- the drums must be securely fastened to the LDV to prevent them from falling/tilting over;
- no personnel are allowed to travel on the back of the LDV;
- the LDV must be surveyed after completion of the transfer;
- personnel involved must wear the prescribed dosimetry.

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7.2.5.6 In the event of a spillage, the LDV must be stopped immediately and measures must be taken to prevent the radioactive liquid from spilling onto the floor/pavement or into drains, and otherwise contain the spillage.

7.2.5.7 Drums must be filled not more than three quarters of the drum capacity.

7.2.5.8 A forklift/hyster is to be used for the lifting of loads containing liquids, weighing more than 25 kilograms.

7.2.6 RP Controls at RP Barriers and SOPs

7.2.6.1 All tools and equipment must be surveyed for radiation and loose contamination on the contaminated side of the SOP before transfer to the clean side. Chemistry may survey their samples when they move their samples over a SOP.

7.2.6.2 The SOP is the only place from where to survey small items for transfer and not over any other physical RP barrier, if not practical, an extension of the contaminated area may be made for frisking and taking smears of items. E.g. frisking table or by laying plastic on the floor.

7.2.6.3 Swipes and smears to be handled correctly to prevent cross contamination. E.g. wear correct PPE, close sample bags, for smears/swipes set up a frisking station. Survey frisking station for contamination on completion of task and check swipes and smears by probe and Cronos, if practical.

7.2.6.4 For large items, assess if more than one RP qualified person is needed for the surveys. One RPM on the contaminated side of the SOP for taking swipes/smears another RPM on the clean side to check the swipes/smears.

7.2.6.5 Contaminated tools, equipment including Chemistry Samples must be properly bagged, wrapped or placed in watertight transfer containers (preferred method) before transfer over SOP`s. Special attention must be given to wrapping underneath equipment, open ends of pipes/valves (flanges must be covered with blank flanges), sharp edges, lifting points, the potential of liquids leaking from components and damages that may occur to wrapping/bagging during transfers.

7.2.6.6 Contaminated or potentially contaminated equipment may not be transferred into a container over a SOP without being properly bagged or wrapped. E.g. bulk equipment to be moved into a container at the 0m airlock.

7.2.6.7 Equipment with no loose contamination on outer surfaces and with no risk that any internal contamination can spread to the outside may be moved into a container over a SOP provided the container or the equipment is watertight, the pathway to the container is properly laid down with plastic and proper contamination controls are in place. E.g. SOP, barriers and radworkers dressed in correct protective clothing.

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7.2.6.8 Cross contamination to slings, trolleys, trailers, trucks, forklifts and other transfer equipment must be considered and must be surveyed after each transfer and on completion of the equipment transfer.

7.2.6.9 Radioactive equipment may only be moved by a radworker with the permission of the RPM when all the radiation and contamination surveys, counting of smears/swipes and attachments of transfer certificates are completed. Chemistry may move their samples over a SOP without the permission of RP.

7.2.6.10 Tools and equipment are not allowed to be passed over or under RP barriers other than the SOP area. Only equipment/tools that are too large and /or needs to be rigged may be taken over a barrier with RP`s permission.

7.2.6.11 RP barriers to be treated as if invisibly extend from the floor to the ceiling of the area.

7.2.6.12 Perform a survey of the SOP and the clean areas outside the barricaded area to ensure that it is still clean after the transfer of contaminated tools/equipment. Verify the conditions of the clothing/radwaste bags by performing a general area radiation survey at the bags to ensure all high active bags are removed when general area dose rates from the bags exceed 50 µSv/h, in areas where the general area dose rates are < 50 µSv/h.

7.3 Storage

7.3.1 Tools and equipment including that used by Chemistry should be decontaminated before being stored.

7.3.2 Any tools or equipment including that used by Chemistry with fixed contamination levels exceeding 5000 ccpm (L-177) or 90 ccps must be decontaminated before storage in controlled zone tool stores or Chemistry stores. No smearable contamination is permitted on tools/equipment for storage purposes.

NOTE:

- *Any tool or equipment that is moved over a SOP and not declared clean through swipe and/or smear survey on equipment and that is not dedicated to be moved to and used in another contaminated/SOP area, must be taken to the decon workshop immediately.*
- *The RPM must ensure that the equipment that is moved to another contaminated area is not contaminated to higher levels than the levels of the destination area.*
- *If the equipment has a higher level of contamination then it must be escorted by a RPM to the tool store to ensure that the equipment is taken to the decon workshop.*

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- *No Red, Yellow or Green bags may be opened in the tool store or any non-contaminated area outside the CZ. (Chemistry may open sample bags in the Chemistry laboratories).*

- *Decontaminated equipment from the DWS in Red bags and washed CZ clothing from the hot laundry in Green bags may be opened in a non-contaminated CZ area after approval from the Duty SRPA.*

- *Only bags with a valid Transfer Certificate or CZ Equipment tag stating items are free from loose contamination may be opened in a non-contaminated CZ area after the approval from the Duty SRPA.*

7.3.3 Unconditionally released equipment is allowed to be placed on the non-controlled zone side of the exit control point immediately once released.

7.3.4 Contaminated equipment waiting to be transferred to another controlled zone shall be kept on the controlled zone side of the exit point until collected. Only for immediate collections can the material/equipment be placed on the non-controlled zone side of the exit point, provided an escort is in attendance.

7.3.5 Shielding should be used to lower the ambient dose rate in areas where high radioactive material is stored.

7.3.6 The storage area must be surveyed on a frequent basis, as well as when material has been moved into or from the area.

7.3.7 Radioactive material shall be properly demarcated and signposted appropriately as soon as possible after identification.

7.3.8 Where there are no physical boundaries, the area must be defined by using appropriate barriers.

7.3.9 Equipment or radioactive material stored must:

- have no smearable contamination;

OR

- be in a container/wrapping that will prevent the spread of any smearable contamination for the duration of the storage.

7.3.10 Entrance areas where radioactive material is stored must be surveyed daily, if radioactive material or equipment has been moved into these areas or else at least weekly.

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7.4 Rigging Equipment

7.4.1 Rigging equipment dedicated for use in the controlled zones may not be released from the controlled zone.

7.4.2 The use of non-dedicated rigging equipment must be minimised as far as possible inside the controlled zone. It must be confirmed that the rigging equipment did not come into contact with water before it can be cleared.

7.5 Wood/Scaffolding Equipment

7.5.1 The radioactivity level is determined using a contamination instrument for both fixed and smearable contamination. The techniques described in paragraph 7.2.1 must be employed.

7.5.2 Wooden scaffolding boards should be colour coded for easy identification.

7.5.3 Wood may be treated as surface contaminated material if it can be verified that no activity could have seeped into the wood by any means. Wood that has been treated, e.g. painted or sealed, can be cleared unconditionally, even if the wood was exposed to water for short periods of time (e.g. splashing or spraying) provided no damage to the sealing media has occurred including cracks/splits. No untreated wood that has been exposed to water inside the controlled zone, no matter how short the duration, may be cleared unconditionally as surface contaminated material. The criteria for volume contaminated material will apply.

7.6 Volume Contaminated Material

7.6.1 This category includes, solid concrete, filters, resins, and porous materials, but excluding wood that can be regarded as surface contaminated material (see paragraph 7.5) and liquids/oils with volume < 1 litre.

7.6.2 The radioactivity level may not be determined by means of a contamination instrument or dose rate instrument.

7.6.3 A gamma spectrometry analysis must be performed on the material, or a representative sample thereof, in order to determine the radioactivity levels and to identify if the material may be unconditionally released or discarded as radwaste.

7.6.4 The material must be mixed uniformly as far as possible.

7.6.5 Dilution of the material in order to meet the clearance level is not permitted.

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7.6.6 The analysis of the gamma spectroscopy results must satisfy the following release criteria:

7.6.6.1 All natural products must have individual activity below 2E5 Bq/m³ with the exception of:

a) The activity of all Principal Gamma Emitters is not to exceed their respective release criteria. See Appendix 1

b) The MDA for all Principal Gamma Emitters must be less than their respective release criteria.

c) All other nuclides (excluding naturals) identified to have activity < 2.5 Bq/m³. Not necessary to check MDA for these.

d) The activity of the Uranium/Thorium series excluding Radon must be < 5E5 Bq/m³. The MDA for these must be < 5E5 Bq/m³ as well.

e) Activity of K-40 found in material used for building construction must be < 1E7 Bq/m³. The MDA must also be < 1E7 Bq/m³.

f) Activity of K-40 in all other materials must be < 5E7 Bq/m³. The MDA must also be < 5E7 Bq/m³.

7.7 Control of Freight Containers for the Storage of Contaminated Material/Equipment

7.7.1 The Freight Container Storage Yard (LLW Building) and other areas where freight containers are stored, are designated radioactive material and waste storage areas, and are subject to the following controls:

- All freight containers (containing radioactive material) must be locked with a RP lock when not in use.
- Freight containers used to store or transfer radioactive material shall be numbered and a register kept of the location and content of the container.
- If radiological conditions on the outside of the freight container meets the criteria for radiological controlled zone in accordance with KAH-002 ,then the necessary RP controls must be instituted.
- Information containing the contents, including the doserates and the radiological status of the equipment in the freight container, must be available either at the freight container or at RPOO.
- RP must be in attendance whenever a freight container is opened or transferred.

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- No freight container may be opened or moved without the duty SRPAs or day shift SRPA's approval.
- Whenever a freight container is opened, the inside of the container must be surveyed for contamination.
- When in storage, the exterior accessible surfaces of the freight containers must be surveyed routinely for contamination and radiation.
- Personnel who enter a freight container must use an appropriate RPC, wear appropriate protective clothing and dosimetry and may only do so under constant RP supervision.

NOTE: *The freight containers must be sent to the Decon Workshop for decontamination of the contents, if contamination levels dictate, before the container and its contents may be transferred to another controlled zone for use.*

7.7.2 Additional Control Measures for a Freight Container Storage Yard.

- Containers other than freight containers may be stored in the yard, subject to the approval of the Duty SRPA or day shift SRPA.
- Regular inspections for damage/deterioration must be performed by RP.

7.7.3 Following container movement into, from, or within LLW container yard or any other area where radioactive material is stored, a radiation survey must be performed at the fence / outer walls and office areas in close vicinity. If the doserates at any point of the fence / outer walls exceeds > 2.5 µSv/h or doserates at office areas exceed-limits as stipulated in KAH-002, Day shift SRPA (or Duty SRPA after hours) must arrange for the containers to be re-arranged or moved until the doserates are acceptable.

7.7.4 The "transfer of Containers Certificate" must be used for all freight container movements between controlled zones or any storage area, including containers moved from inside Fuel Building loading bay to the outside or versa, and between Unit 1 and Unit 2 PTR tanks (outside).

7.7.5 On arrival of one container at a destination, inform the SRPA Days, tear off and forward section B of the container transfer certificate to the SRPA Days during normal office hours, Duty SRPA to be called after hours.

7.7.6 Each SRPA Days is to ensure a log entry indicating the container number and final location during normal office hours.

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7.7.7 If the container movement is done after hours, the Duty SRPA is to ensure a log entry of the container movement - indicating the container number and final location. He/she also ensure that the bottom part of the transfer certificate is placed in the dayshift office in a dedicated container transfer tray.

7.7.8 The SRPA Days to update the tracking spreadsheet and container location map on G-drive and to reconcile the certificates with the Duty SRPA logged entries.

7.8 Packing

7.8.1 General Provisions

NOTE: *In terms of procedure KAA-634 radworkers are ultimately responsible to ensure that equipment under their control is properly contained and/or wrapped.*

7.8.2 Packing for Transfer between Controlled Zones On-site (General)

7.8.2.1 The preferred method for transferring equipment and material between Controlled Zones will be the use of a reusable robust Transfer container, instead of plastic wrapping. The Transfer containers may be packed with non-wrapped equipment originating from a potential radiological contaminated area which must be free of loose radioactive contamination on external surfaces. The equipment must be transferred directly to the decon workshop, if possible. The equipment must be unpacked and the transfer container shall be surveyed for contamination. The transfer container shall be free of radioactive contamination both fixed and loose on all external surfaces. If detected during the surveillance of the container shall be decontaminated.

7.8.2.2 Green bags are used for the storage and transport of controlled zone protective clothing and respiratory equipment within and between controlled zones.

7.8.2.3 Red bags are used to store and transport contaminated re-usable and small items, tools and equipment within and between controlled zones.

7.8.2.4 For Chemistry liquid samples the sample bottles and sealable bucket containing absorbent material for transfer will be permitted for the transport of their material.

7.8.2.5 Yellow bags are used for the storage and transport of contaminated compactable waste, and small disposable items of non-compactable waste within and between controlled zones.

7.8.2.6 Yellow plastic sheeting is normally used to package large items of non-compactable waste for storage and transport within and between controlled zones. The use of sheeting should be minimised by using alternatives, where possible.

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7.8.2.7 Red plastic sheeting is normally used to package large items and equipment for storage and transport within and between controlled zones. The use of sheeting should be minimised by using alternatives, where possible.

NOTE: *See paragraph 7.8.4 for special cases.*

7.8.2.8 Yellow 210 litre metal drums (not oil drums) are used to dispose of and transfer/transport low active radioactive waste.

7.8.2.9 Oil is stored in approved oil drums, marked for this purpose, and stored in a designated temporary storage area before being moved to the site oil storage facility, or the LLW Building, depending on the radioactivity levels.

7.8.2.10 Yellow 50 litre plastic drums marked with a trefoil are used to store and transfer radioactive material.

7.8.3 Packing for Transport Off-site

7.8.3.1 The packaging of material for transport off-site will be in terms of the IAEA regulations for the category of material. This is documented in KWH-S-037.

7.8.4 Packing for Transfer between Controlled Zones On-site (Special Cases)

7.8.4.1 Wet Internal Conditions

- For equipment, dual containment will be used for containing contamination. Measures must be taken to contain liquids in components in any orientation of the component.
- For chemistry water samples, the primary package (watertight container) must be a polythene bottle with a sealable top. The secondary package must be a red bag, or a designated sealable bucket together with absorbent material.
- For oil samples, the primary package (watertight container) must be a polythene bottle with a sealable top, wrapped in PVC. The secondary package must be a red bag.
- Used oil will be contained in the appropriate approved container. When the radioactivity levels are found, after analysis, to be above the levels for radioactive material the oil will be stored in a yellow oil drum (where possible) in the LLW Building if the dedicated oil storage tanks for this purpose are unavailable.

7.8.4.2 Large Items of Equipment

- Large pieces of equipment should be contained in single packaging if wet internal conditions are not expected. Equipment that is sealed in such a way as to prevent leakage during transfer does not need to be wrapped fully.

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- For very large pieces of equipment, e.g., the Klockner, only those parts with loose contamination should be wrapped.

- The Klockner should be contained in a pre-designed single cover of any colour, excluding transparent / clear plastic, provided that the outer surface of this cover is properly tagged and signposted with radiation trefoils.

7.8.4.3 Small Items of Equipment

- These are packaged using any of the methods described in paragraph 7.8.2. For dry internal conditions, dual containment is not required and must be specified by the RP representative. A number of small items can also be contained in a large freight container, which will then serve as the primary packaging.

  NOTE: *Measures shall be taken to prevent cross contamination of items inside the container e.g. segregation, sorting, packaging.*

7.9 Disposal

7.9.1 No pressurised containers will be disposed of unless punctured, or emptied, and the valves left open. These containers must be disposed of in drums marked "NCW".

7.9.2 Non-flammable liquid must be disposed of in the allocated plant floor drain, with the prior approval from the Liquid Waste Co-ordinator.

7.9.3 Wet compactable waste must be disposed of in bags and drums specifically marked for this purpose. The Controlled Zone Equipment Tag, or the Transfer Certificate, may be used to identify the manner of disposal.

7.9.4 No oil to be transferred to the LLW store for storage until disposal. R

7.9.5 Clean oil is disposed of at the site oil storage location.

7.9.6 Contaminated compactable waste is disposed of in yellow bags.

7.9.7 Liquids (Including Oil)

7.9.7.1 For all liquids including oil (one litre and more) which must be cleared unconditionally from any controlled zone including the Hot Lab, Chemistry building, representative sample must be taken and analysed by Chemistry. The Authorised Person (Effman) to verify it is a representative sample). An Authorised Person (Effman) must evaluate these results before it may be released.

7.9.7.2 The radioactivity level may not be determined by means of a contamination instrument or dose rate instrument.

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7.9.7.3 Dilution of the liquid in order to meet the clearance level is not permitted.

7.9.7.4 A sample (minimum 40ml) must be taken for release of liquid volumes < 1 litre.

7.9.7.5 The levels stated in the procedure appendix 1 must be able to be detected.

7.9.7.6 Release of liquids/oil of volume greater/equal to 1 liter:

- The sample must be 1 litre.
- The MDA for all Principal Gamma Emitters must be < 2E4 Bq/m³.
- No activity, excluding natural products, must be detected.
- The release criteria for the Uranium/Thorium series is < 5E5 Bq/m³.
- The MDA for the Uranium/Thorium series must also be < 5E5 Bq/m³.
- Activity of K-40 found in material used for building construction must be < 1E7 Bq/m³. The MDA must also be < 1E7 Bq/m³.
- Activity of K-40 in all other materials must be < 5E7 Bq/m³. The MDA must also be < 5E7 Bq/m³.

NOTE 1: *If the MDA is above criteria, Chemistry to count sample longer or request RP Development to assess report for release.*

NOTE 2: *If activity is above MDA but below the levels above or in Appendix 1, Chemistry can be requested to count the sample for a shorter time. This will result in a higher MDA.*

7.9.7.7 Criteria for natural products:

(1) Ensure activity of each nuclide except those in 7.9.7.7(2), 7.9.7.7(3) & 7.9.7.7(4) does not exceed 2E5 Bq/m³.

(2) Activity of each radionuclide in the Uranium-Thorium series and its progeny, excluding Radon, does not exceed 5E5 Bq/m³.

(3) Activity of Potasium-40 from the construction building material does not exceed 1E7 Bq/m³.

(4) Activity of Potasium-40 from other material does not exceed 5E7 Bq/m³.

(5) The MDA for all natural products must not exceed the release criteria for that nuclide even if the nuclide is not detected.

See Appendix 1 for principle gamma, radionuclides.

7.9.7.8 Quantities smaller than one litre shall be cleared as per criteria currently documented in 7.6.

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7.9.7.9 A radiological and contamination survey of the outside of the container is still required, and the Unconditional Clearance Checklist (KFH-HP-189), shall be completed. The gamma spec analysis shall be cross referenced in the clearance survey. Liquid containers with or without liquids for unconditional release should be placed in the Cronos-4, as well, if it does not exceed the weight criteria of the Cronos-4 and fit into the Cronos-4 for unconditional release.

7.9.7.10 A copy of the Chemistry analysis must be attached to the Unconditional Clearance Checklist (KFH-HP-189).

7.10 Radwaste Volume Minimisation Guidelines

7.10.1 Radioactive material should be segregated at the source. Material not contaminated must be kept separate from contaminated material in order to prevent cross-contamination.

7.10.2 Tools and equipment dedicated for use in the controlled zone should be used as far as possible and should be distinctly painted/marked for easy identification.

7.10.3 Wood should only be allowed in the controlled zone under exceptional circumstances, and then only if it complies with the requirements for treating wood as surface contaminated material. This will ensure that the wood can be easily decontaminated and cleared from the controlled zone.

7.10.4 Non-porous plastic can be used as a replacement for wooden pallets, and metal scaffolding instead of wooden scaffolding.

7.10.5 Only the minimum amount of material, tools or equipment should be taken into the controlled zone.

7.10.6 Precautions should be taken to prevent the contamination of special tools and equipment used in the controlled zone.

7.10.7 Tools for dedicated use in the controlled zone should have properties that make it easy to decontaminate them.

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8.0 ACCEPTANCE CRITERIA

N/A

9.0 RECORDS

9.1 KFH-HP-189, ‘Unconditional Clearance Checklist’ and ‘Portable Instrument Bulk Release form’, KFH-HP-187, are non-permanent records and must be retained according to KSH-008 requirements.

10.0 ATTACHMENTS

Appendix 1 – Clearance Levels for Selected Radio Nuclides

Appendix 2 – Table T-11-5.2-1: Nuclide Selection

Appendix 3 – Justification

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APPENDIX 1

CLEARANCE LEVELS FOR SELECTED RADIO NUCLIDES

LIST OF PRINCIPAL GAMMA EMMITTERS 1a

Radio Nuclide	Activity Concentration (Bq/l
Mn-54	50
Co-58	50
Co-60	120
Ag-110m	70
Sb-125	50
Cs-134	50
Cs-137	50

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APPENDIX 1 (continued)

CLEARANCE LEVELS FOR SELECTED RADIO NUCLIDES

LIST OF THORIUM/URANIUM SERIES 1b

Thorium series: Thorium, Actinium, Bismuth, Lead, Polonium, Radium, Radon, Thallium.
Uranium series: Uranium, Astatine, Bismuth, Lead, Polonium, Protactinium, Radium, Radon, Thallium, Thorium

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APPENDIX 2

TABLE T-11-5.2-1: NUCLIDE SELECTION

TABLE T-II-5.2-1: NUCLIDE SELECTION

NUCLIDE SELECTION					
The following nuclides have been selected by the process described in *Section II-5.2.1.1* and detailed in *Reference 3*.					
H 3	Rb 86	Mo103	Cd117	Te131m	Cs137
C 14	Rb 88	Mo104	In115m	Te131	Cs138m
Cr 51	Rb 89	Mo105	In117m	Te132	Cs138
Mn 54	Rb 90m	Tc 99	Sn113	Te133m	Cs139
Mn 56	Rb 90	Tc 99m	Sn117m	Te133	Cs140
Fe 55	Rb 91	Tc101	Sn119m	Te134	Ba135m
Fe 59	Sr 89	Tc103	Sn121	I128	Ba137m
Co 58	Sr 90	Tc104	Sn123	I129	Ba139
Co 60	Sr 91	Tc105	Sn125	I130m	Ba140
Ni 63	Sr 92	Tc106	Sn127	I130	Ba141
Cu 64	Sr 93	Ru103	Sn128	I131	Ba142
Ge 78	Sr 94	Ru105	Sn129m	I132	La140
As 77	Y 90	Ru106	Sn130	I133	La141
As 78	Y 91m	Ru107	Sb122	I134m	La142
Se 81	Y 91	Ru108	Sb124	I134	La143
Se 83	Y 92	Rh103m	Sb125	I135	La144
Se 84	Y 93	Rh104	Sb126	I136	Ce141
Br 82	Y 94	Rh105	Sb127	I136m	Ce143
Br 83	Y 95	Rh106	Sb128	Xe129m	Ce144
Br 84m	Zr 95	Rh106m	Sb128m	Xe131m	Ce145
Br 84	Zr 97	Rh107	Sb129	Xe133	Ce146
Br 85	Zr 98	Rh109	Sb130	Xe133m	Ce147
Br 86	Nb 95	Pd109	Sb130m	Xe135m	Ce148
Br 86m	Nb 95m	Pd111m	Sb131	Xe135	Pr142
Br 87	Nb 96	Pd111	Sb132	Xe137	Pr143
Kr 83m	Nb 97m	Pd112	Sb132m	Xe138	Pr144
Kr 85m	Nb 97	Ag110m	Sb133	Xe139	Pr145
Kr 85	Nb 98m	Ag111	Te125m	Cs132	Pr146
Kr 87	Nb 99m	Ag112	Te127	Cs134m	Pr147

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APPENDIX 2 (continued)

TABLE T-11-5.2-1: NUCLIDE SELECTION

NUCLIDE SELECTION					
The following nuclides have been selected by the process described in *Section II-5.2.1.1* and detailed in *Reference 3*.					
Kr 88	Mo 99	Ag113	Te127m	Cs134	Pr148
Kr 89	Mo101	Cd115	Te129	Cs135m	Pr149
Kr 90	Mo102	Cd115m	Te129m	Cs136	Nd147
Nd149	Pm151	Eu155	Hf179m	Np238	Am244
Nd151	Pm152	Eu156	Hf181	Np239	Cm242
Nd152	Pm153	Eu157	Ta182	Np240	Cm244
Pm147	Sm151	Eu158	Ta183	Pu238	Zn65
Pm148	Sm153	Gd153	W187	Pu240	Na24
Pm148m	Sm155	Gd159	Re188	Pu241	Be7
1539 Pm149	Sm156	Tb160	U237	Pu243	U-235
1539 Pm150	Eu154	Tb161	U239	Am242	Cs-135
1539 U-236	U-238	Np-236	Np-237	Pu-239	Co-57
1539 Pu-242	Pu-244	Am-241	Am-242m	Am-243	Cm-243
1539 Cm-245	Cm-246	Cm-247	Cm-248	Cm-250	Cf-249
1539 Cf-251	Be-10	Cl-36	Ca-41	Ni-59	Se-79
1539 Zr-93	Mo-93	Nb-94	Pd-107	Ag-108m	Sn-121m
1539 Sn-126	Ar-41				

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APPENDIX 3

JUSTIFICATION

Revision 12

1. Full review and to include DTCR Rev 11T0.
2. 7.6.6.1: All natural products must have individual activity below 2E5 Bq/m³ with the exception of:
   a) The activity of all Principal Gamma Emitters is not to exceed their respective release criteria. See Appendix 1.
   b) The MDA for all Principal Gamma Emitters must be less than their respective release criteria.
   c) All other nuclides (excluding naturals) identified to have activity < 2.5 Bq/m³. Not necessary to check MDA for these.
   d) The activity of the Uranium/Thorium series excluding Radon must be < 5E5 Bq/m³. The MDA for these must be < 5E5 Bq/m³ as well.
   e) Activity of K-40 found in material used for building construction must be < 1E7 Bq/m³. The MDA must also be < 1E7 Bq/m³.
   f) Activity of K-40 in all other materials must be < 5E7 Bq/m³. The MDA must also be < 5E7 Bq/m³.
3. 7.9.7.6: Release of liquids/oil of volume greater/equal to 1 liter.
   - The sample must be 1 litre.
   - The MDA for all Principal Gamma Emitters must be < 2E4 Bq/m³.
   - No activity, excluding natural products, must be detected.
   - The release criteria for the Uranium/Thorium series is < 5E5 Bq/m³.
   - The MDA for the Uranium/Thorium series must also be < 5E5 Bq/m³.
   - Activity of K-40 found in material used for building construction must be < 1E7 Bq/m³. The MDA must also be < 1E7 Bq/m³.
   - Activity of K-40 in all other materials must be < 5E7 Bq/m³. The MDA must also be < 5E7 Bq/m³.

     ***NOTE 1**: If the MDA is above criteria, Chemistry to count sample longer or request RP Development to assess report for release.*

Revision 12a

1. Change paragraph 7.9.4 of page 24 to reflect the following: “No oil to be transferred to the LLW store for storage until disposal”. As per GA 40748.

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