DANSK DEKOMMISSIONERING

Notat

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Behandlingsstationen

Radiological Characterization and Decommissioning in Denmark

Danish Decommissioning (DD) is currently decommissioning the last Danish research reactor (DR3) and the Hot Cell facility.

The DR3 project will soon finish dismantling of the external parts of the reactor (January 2012). The approval for dismantling of neutron activated and tritium contaminated heavy water pumps and tubing was granted in December 2011.
DD will begin the work on the inner parts as the tendering process for equipment will start in 2012. Hereafter the dismantling of the top of the reactor will begin using the obtained remote controlled equipment.

The Hot Cell facility consists of 6 contaminated cells. The first cell have been opened and cleaned. Currently the work progresses by removing parts and hot spots from the other cells with the use of robotic equipment. Challenges, lack of conventional and radiological documentation, dose rates and contamination higher than expected and the confined space in the cells have delayed the project.

No final repository exists in Denmark. Therefore no official Waste Acceptance Criteria (WAC) have been formulated. However the Danish authority (SIS) does require a description of the waste in the interim storage facility (Inventory). Furthermore radiological characterisation of key nuclides is needed during decommissioning and dismantling. The information gained from the characterisation helps in the planning phase prior to the dismantling and for inventory calculations for later use. DD performs the radiological characterisation via both non-destructive and destructive analysis on samples.

The samples are measured with gamma spectroscopy using mathematical and geometrical analysis. Scaling factors are used for neutron activated waste (DR3) to determine the difficult-to-measure isotopes and pure beta emitters. The primary scaling isotope is Co-60. Waste from the Hot Cell facility is alfa contaminated and scaling procedures for determination of alfa contamination are currently used in the planning process. Scaling of alfa emitters will be incorporated into the inventory calculations.

Due to the variable nature of the systems being decommissioned, the sampling procedures are based on ad hoc principles. The number of samples needed is determined by the conventional characterisation of the systems. For systems where conventional knowledge is limited, more samples are generally needed earlier in the decommissioning process. Otherwise sampling can take place prior to the packing of the containers for the interim storage facility. In this case less sampling is needed as few representative samples for each material from each system in the container are sufficient.

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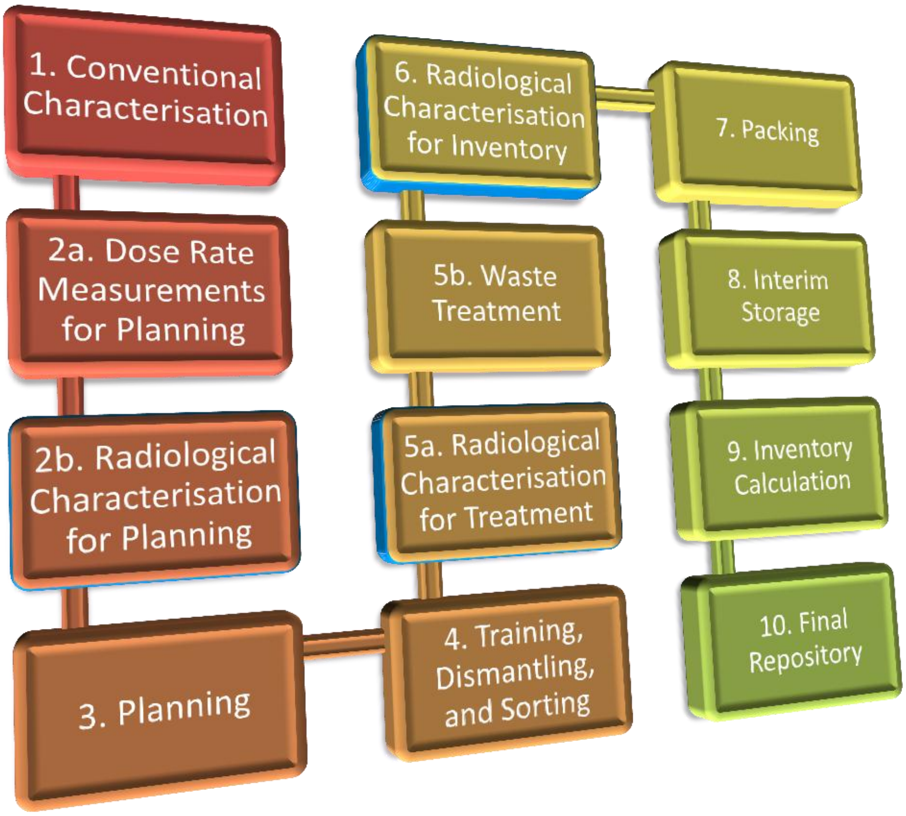
Discussion, power point preparation:
Standardized waste flow. An Ad Hoc approach eliminates unneeded steps.



~~Usually step 5 is skipped and placed in step 2 and the planning incorporates how the waste should be treated. Otherwise step 7 is skipped and placed in step 5 if the waste is not to be treated. The approach tries to eleminate either steps to save time and money. Ideally both step 5a and 6 are placed in step 2, but this can only be done if it is known beforehand which part of the dismantled system is put in which container. This is the case for small systems that are well characterised konvenionally when the key isotopes in the system are well known.~~

Representative sampling
When in the process is the sample most representative? Early in the process it might not be representative for the container (how do you pack it into the container after sampling?). Late in the process knowledge might be lost about the precise origin of each waste item (where was the hottest part?). The best step in the decommissioning process to take samples changes from system to system.

The engineer needs to look at the whole process
Knowledge about isotopes is sometimes needed in the planning phase. Characterisation should then be done before the planning phase. Can this knowledge be used after the dismantling? Is it well known which dismantled parts contain which amount of isotopes or is it just a averaging that will be required?
If the parts are packed into several containers and the dose rate on the surface of the containers is measured to be different from each other was averaging of the isotopes good enough?

Will the waste treatment facility need more thorough characterisation? What about after the treatment? The amount of isotopes in the waste has changed and new characterisation is needed. How do you take a representative sample? What is the origin of the treated waste? Is it important now? Is the representative sample the hottest part of the treated waste? - Or one sample for each container? Is the treated waste completely uniform and one sample and averaging is sufficient?

If the waste was not to be treated, could this be planned ahead of time so characterisation steps are eliminated? Is the conventional characterisation sufficient for determining where samples should be taken? Can the planning phase determine which parts go into which containers before dismantling?

What if no conventional documentation exists? Are dose rate measurements sufficient to determine where to take samples? Do you then take lots of samples to be on the safe side? What if the dose rate is too high to take lots of samples?

All these questions are individual for each system to be decommissioned and dismantled. A flexible approach is therefore needed that can determine the best approach. There is no general best method. The best method for one system is different from the best method for another system.
The favorable approach is therefore to determine what the best method is for the system in question. This approach is very ad hoc and involves looking at the decommissioning process as a whole. In order to cover all angles several people likely needs to be involved. Can this be done if the requirements for the final characterisation are being determined by external people (governments a final repository, etc)?

This needs a strict system of WAC to ensure that the engineers think about the overall process.

What if you have no final repository and no WAC? Do you in the future need to redo everything you are doing now? Will the future WAC be flexible so you do not need to unpack containers and characterise the waste again?

Again flexibility is needed. Samples can be stored for the future to enable a new characterisation. Representative sampling and documentation then becomes more important.

Denmark has no WAC, so DD stores samples for the future. It is then important to be very ambitious and do the sampling as thoroughly as possible. In practice sampling takes time away from the practical dismantling work and can become a problem if high doses are involved. It is possible to take too many samples – or is it?

How many samples is enough? This depends on what the samples are for. If the uncertainty in calculations based on the samples is high, a few samples are sufficient. If calculations are not done, lots of samples might be needed in order to get an activity distribution. The need for an activity distribution changes from each system to the next. Again a flexible ad hoc approach is better than a strict system.

The flexible approach should be flexible from the start and the final approach should ideally be determined in the planning phase. Hereafter the approach should be as planned in order to avoid unneccessary delays. But what happens if some new knowledge is discovered? What if this knowledge changes the planning completely? Returning to a long planning phase should then be avoided. A flexible way of handling problems is important. Again conventional characterisation is very important. The more knowledge about a system exists beforehand, the less new information will show up later. Thorough conventional characterisation is very important and can sometimes eliminate the need to do radiological characterisation before the planning step. This ensures added flexibility in the sampling as it can be done later in the process.

The first step of the approach should therefore be to collect as much conventional knowledge about the system as possible. One should be aware that old documentation can be wrong, as improvements to the system could have been implemented after the documentation was made. Rarely new documentation was made when systems were improved.

This has happened for DD more than once. During a demolishion of a biological shield, aluminium tubings were discovered inside the concrete. No documentation about the tubings existed. Similarly the decommissioning of the Hot Cell facility faces problems about lack of documentation of work done in the hot cells. Several hot spots are present inside the cells as Cobalt and uranium pellets was dropped onto the floor during the usage of the facility. After the facility was closed down the walls were washed in only some of the cells and the debris were brushed into piles with brooms. These piles were never documented and several hot spots are contained in each pile. Needless to say the project has been delayed by hot spots suddenly being found by workers in unexpected places. In these cases a new planning phase for a new problem is sometimes needed and a new approach has to be decided. Flexibility is a must in decommissioning as the problems faced are extremely varied.