The Use of Functional Modelling in a Safety Audit of Radioactive Flows

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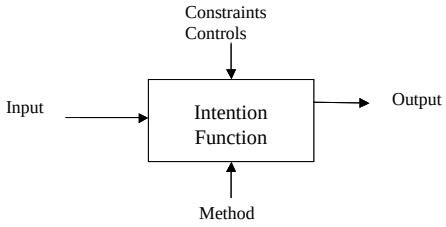
A Functional modelling method has been used to evaluate the safety management procedures for transport of radioactive materials at Risø National Laboratories.
In this case the so-called TOMHID-method has been used. The method is systematic and aims at defining and decomposing the different functions.
The TOMHID- method follows the conventions from "Structured Analysis & Design Techniques" (SADT.

Every function is described as a box with input and output together with control actions and methods involved in the function. At the decomposition of the functions of the handlings of radioactive material, the following is determined for each function:



What is the input to the function?
What is the intention of the function?
What is the method?
What controls the function?
What is the output from the function?

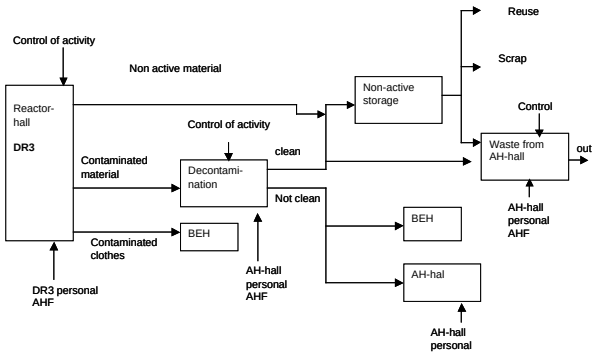
An example of a material flow diagram out of a reactor containment …..

Before the analysis some criteria must be determined.

1. Which are the unwanted situations?
2. How many barriers must be violated before the unwanted situations can occur?

In the Risø study the answers were:

1. Radioactive materials are deposited at a place not intended.
2. At least two barriers must be violated for this to happen.



… and the following analysis:

Function	Event	Consequence	Control	Assessment	Action
Contaminated material from reactor hall Material to waste	Contaminated material assessed not active	Contaminated material goes to non active waste	Control of activity at reactor hall exit. Control of activity at exit AH-Hall	2 failures must occur before the material ends in place not intended	None
Contaminated material from reactor hall Material for storage	Contaminated material assessed not active	Contaminated material goes to non active storage	Control of activity at reactor hall exit.	Just one failure can give the result that active material ends outside Risø. This would be the case in an eventual clearing of the storage.	**Regular activity control of non-active storage** **Activity control of 'non-active 'scrap.**
Decontamination Material to waste	Decontaminated material marked clean even it is still active	Contaminated material exits DR3 as non active waste	Control after decontamination. Control at exit AH-hall	2 failures have to occur before the material ends outside Risø	None
Decontamination Material to storage	Decontaminated material marked clean even it is still active	Contaminated material goes to non active storage	Control of activity after decontamination.	Only one failure can give the result that active material ends outside Risø. This would be the case in an eventual clearing of the storage..	**Regular activity control of non-active storage** **Activity control of 'non-active 'scrap.**

The method gave a very clear overview of the flows and the barriers for uncontrolled radioactive flows. The method can be highly recommended in the planning phase of decomissioning of nuclear plants for assessments of the control functions for transport of waste and other radioactive materials.