Practical Exercise for the IAEA workshop on Safety Assesment at Riso (Denmark)

Dismantling of Fuel Flask
Group B

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List of hazards when using A) mechanical and B) thermal cutting

- Radiological
  - Contaminated material: internal contamination and external exposure of the workers
  - Airborne
- Chemical/toxic
  - Lead
  - Decontamination reagents: commercial type
- Physical
  - Kinetic energy/heavy weight
  - High temperatures
- Working environment
  - Heavy lifts
  - Heavy equipment
  - Falling object
  - Fire

A. Mechanical cutting- Sequences of operations

1. Discussion with operators related with operating history

2. Direct and indirect radiological measurements-done
   - Contamination external 4 Bq/m^2 and internal 10^4 Bq/m^2
   - Dose rate: in bottom area 0.6 μ Sv/h and inside 750 μ Sv/h (at 180 cm inside)

3. Assembling of the metallic platform for fixing the flask in horizontal position for cutting; manpower 4 persons, 6 hours- no radiological impact

4. Decontamination of the flask internal and external parts : textiles and chemical reagents, 1 worker, 4 h, decontamination factor 1/10..1/20, secondary waste resulted textiles-100 litres- by incineration result 500 grams of the ash as radioactive waste, 68 μ Sv for one worker

A. Mechanical cutting- Sequences of operations

- Assembling the tent (isolation system), lighting and portable local ventilation system with the HEPA filters,
- Portable airborne monitoring equipment with the alarm threshold– health and safety conditions,
- Electrical mechanical saw with the saw in vertical position (slow movement),
- Protective equipment for workers: respiratory full mask protective, hand, legs and head protection, cloths, personal dose-meters (TLD and electronic dose -meter with threshold alarm)

A. Mechanical cutting- Sequences of operations

- Radiological criteria: 20 mSv/y for workers and 1 mSv/y for population
- Administrative dose constraints: 10 mSv/y
- Dose rate: 10 μSv/h for workers, 5-6 μSv/h constraints adm.
- After decontamination with decontamination factor 1/10: once executed:
- Dose rate: in bottom area 0.06 μSv/h and inside 75 μSv/h (at 180 cm inside)
- Due to the shield utilization (the lead sheet of 10 mm thickness) on flask during the cutting process:
  in bottom area 0.006 μSv/h and for working position is 7.5 μSv/h

A. Mechanical cutting- Sequences of operations

Cutting:

- Disassembling of external parts: lifting system for fuel, upper components, other external parts detachable
- Assumption – cutting rate 5 mm/min (average)
- 6 pc. – 6 segmented rings
- Total cutting length – 1800 cm – 18000 mm
- The total cutting time – 3600 min – 60 hours
- Individual effective dose for cutting process: 450 μSv

B. Thermal cutting-reasons for exclusions in selection process

- This technique isn't applied due to the following factors:
- Generation of the radioactive and toxic airborne (lead or other heavy metals from the stainless steel)
- Different melting temperature for the stainless steel and lead, this will generate much more the secondary waste in comparison with the case A),
- High hazard of the fire in the tent, high temperature and resulted small pieces from the melting materials, much more comparative with the mechanical technique
- The operation is faster than the mechanical technique but with the higher hazard for workers and population
- Airborne activity per surface contamination F with thermal cutting technique is 0.2 Bq/c.m./Bq/s.cm (see Table 3.6 page 17, and for mechanical cutting technique F= 0.003.

Incidents or accidents, workers A) mechanical cutting

- Physical incident: drop of the ring in final stage of the cutting or during handling- no generate the hazard for public;;

- Electrical shock can generate the fire in tent- no generate the hazard for public;

- Local contamination in the tent by shavings resulted from the cutting process, max 100 kg, shavings, with 10 000 Bq/s.m. total length of cutting: 18 m (conservative), surface removal 18x0.003 (blade thickness)= 0.054 s.m., so total activity from shavings is 540 Bq with Co-60 contaminants, so very low dose rate for workers 0.2 nSv/h, volume of tent (10x2x3)= 60 c.m., 9 Bq/c.m. (0.009 Bq/l) in air if all 540 Bq Co-60 in air- no hazard for the workers and public, airborne activity per surface contamination F calculated= 0.003 Bq/c.m./Bq/s.cm, air exchange rate from tent 1,000 excahnge per hour , release rate during cutting – 20 Bq/m/ Bq/s.cm, cutting speed 0.3 m/h

Incidents or accidents, workers A) mechanical cutting

- Mitigating measures:
- **working procedures** (for cutting, decontamination in semi-wet and dry conditions, packaging, radiation protection, preparedness and response in radiological emergency situations), training of the workers based on working procedures, decontamination techniques available in place, using the plastic foil for prevention spreading the contaminants when cutting and handling the segmented parts, put in the area assigned the fixed dose meters with threshold alarm;
- **administrative control**: the fences and labels for prevention of unauthorized access to the area assigned for dismantling;
- **industrial safety** measures in place, using the standard and additional chain for lifting and handling segmented parts, fire extinguishers, vacuum cleaners with HEPA filters, plastic foil, adhesives-scotch for plastics, labels, authorized crane and worker, tent with detachable floor, drum - 100 l, mechanical tongues, ground protected electrical circuit

Normal operation, public

- No public effect , in normal operation case A), mechanical cutting

Incidents or accidents, public

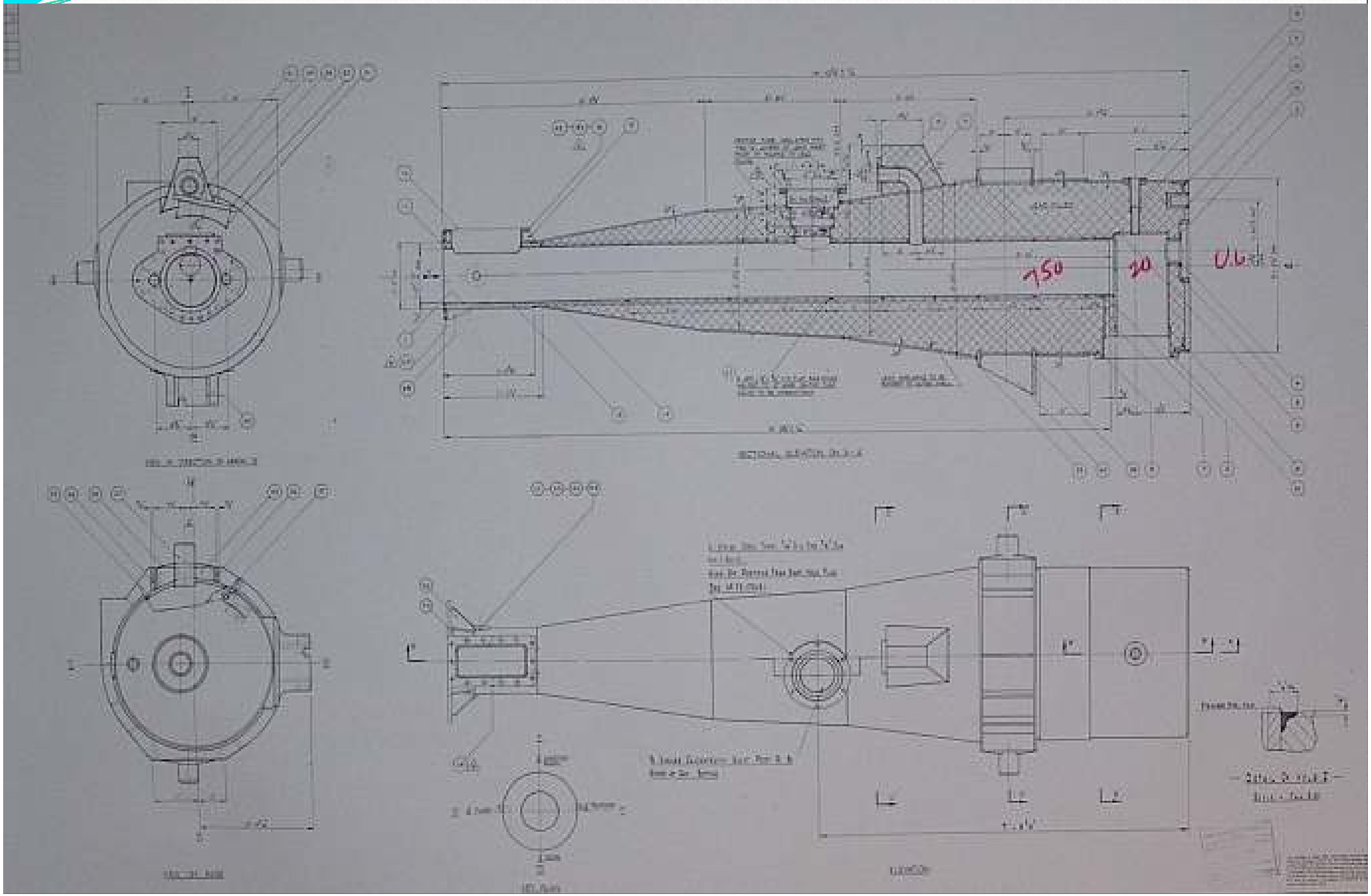
- In case A) mechanical cutting no consequences for the public

Summary

- Mechanical cutting technique is preferable option for the dismantling of the fuel flask
- Duration of the segmentation is about 60 h; duration of dissembling external parts: 40 h, duration of decontamination: 4 h
- Total duration of the dismantling: 104 h
- The estimated individual effective dose is 518 μ Sv
- The collective dose for operation(one flask) is 1.418 man·mSv
- After segmentation, based on the costs-benefits analyses, it will be applied an appropriate decontamination method for free release of the materials resulted or final disposal
- No radiological consequences were identified for the population

Summary

The analysed case for the flask dismantling has clearly shown that the dismantling design and safety analysis are closely interconnected and should be developed in parallel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