Pre-Conceptual Study on the Review Framework for the Radiation Shielding Safety of the PWR Spent Fuel Cask Interim Storage in Korea

TopSeal 2006, Olkiluoto, Finland

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Contents

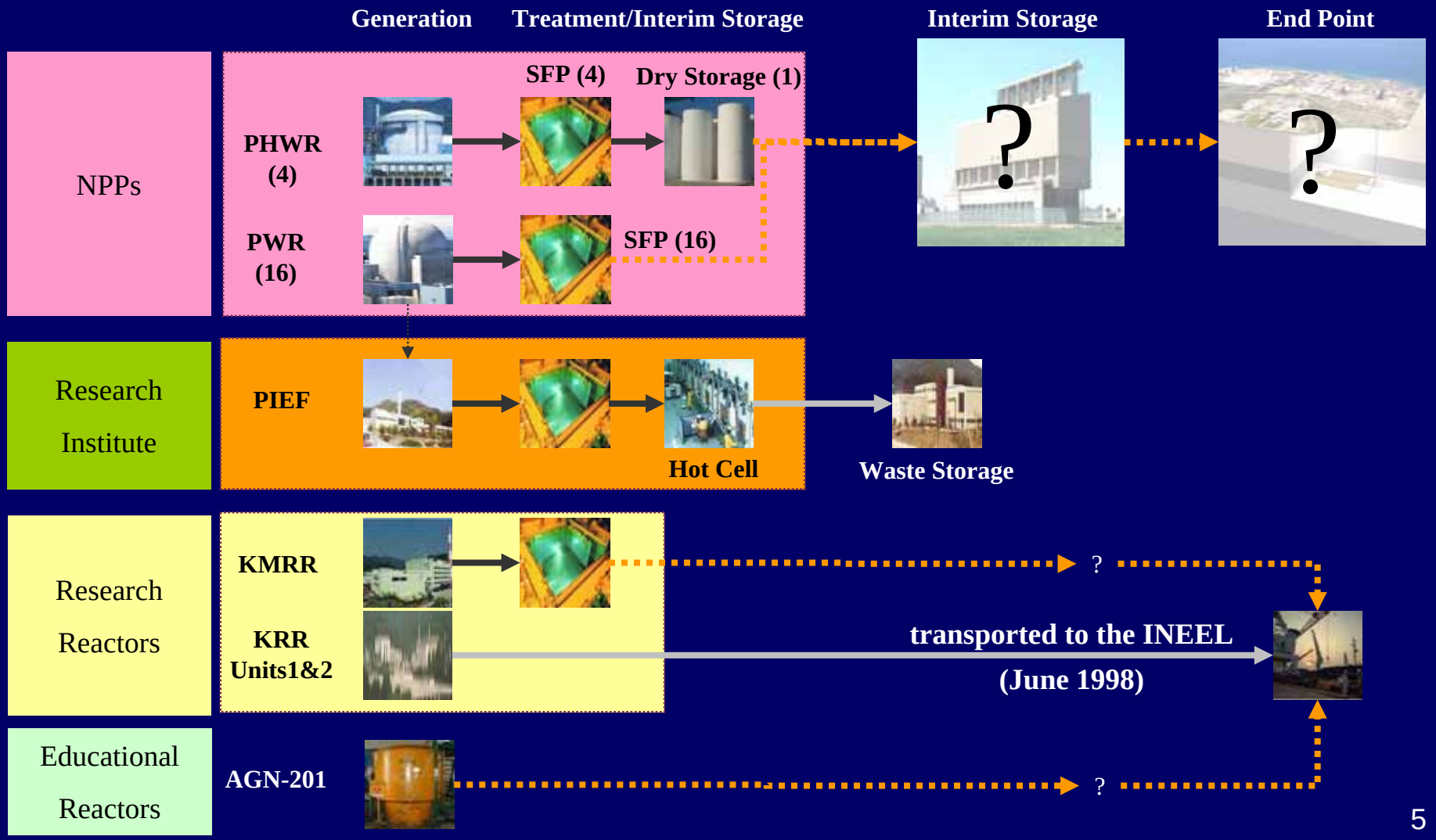
1. Introduction

- Regulatory demand for the interim storage for PWR spent fuels around 2016 in Korea
  - » The national policy is that spent fuels be stored within each NPP site until 2016
    - Around 2016, the interim storage facility for PWR spent fuels might be considered
  - » Regulatory demand on the safety review of interim storage facility might occur
    - Necessary to develop a review framework
- Review framework being developed NOW !

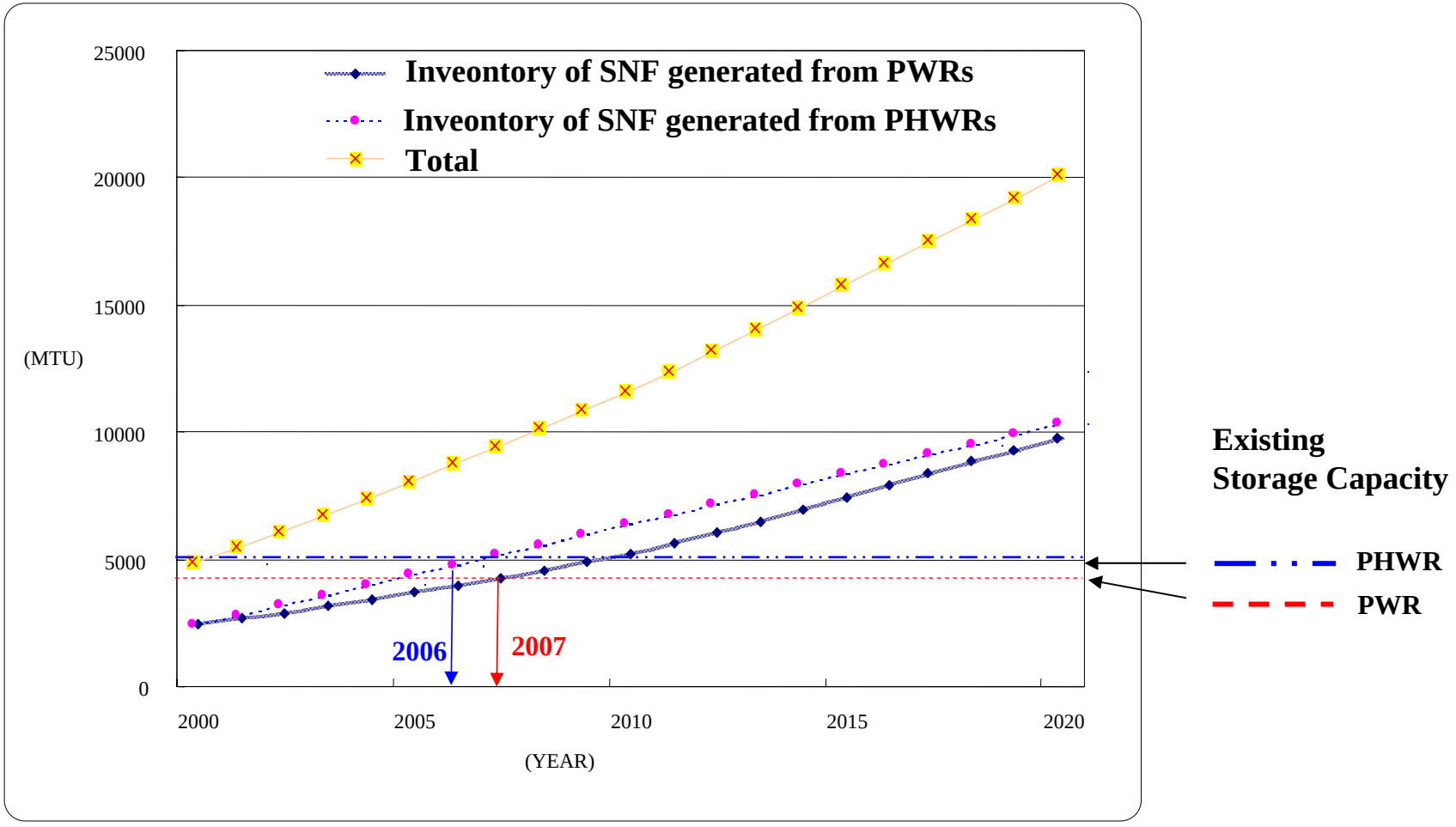
1.1 The Latest National Policy on SNF Management

- In the 253th AEC (2004)
  - » National policy on SNF management
    - to be decided in the view of the domestic and international technology development later on, through public deliberation and consensus
  - » Temporary Storage of SNF
    - to be stored at each NPP site until 2016, by expanding existing onsite storage capacities
      - High density storage racks & onsite transportations
- After 2016 ?
  - The possibility of the interim storage

1.2 Overview of National Framework of SNF Management

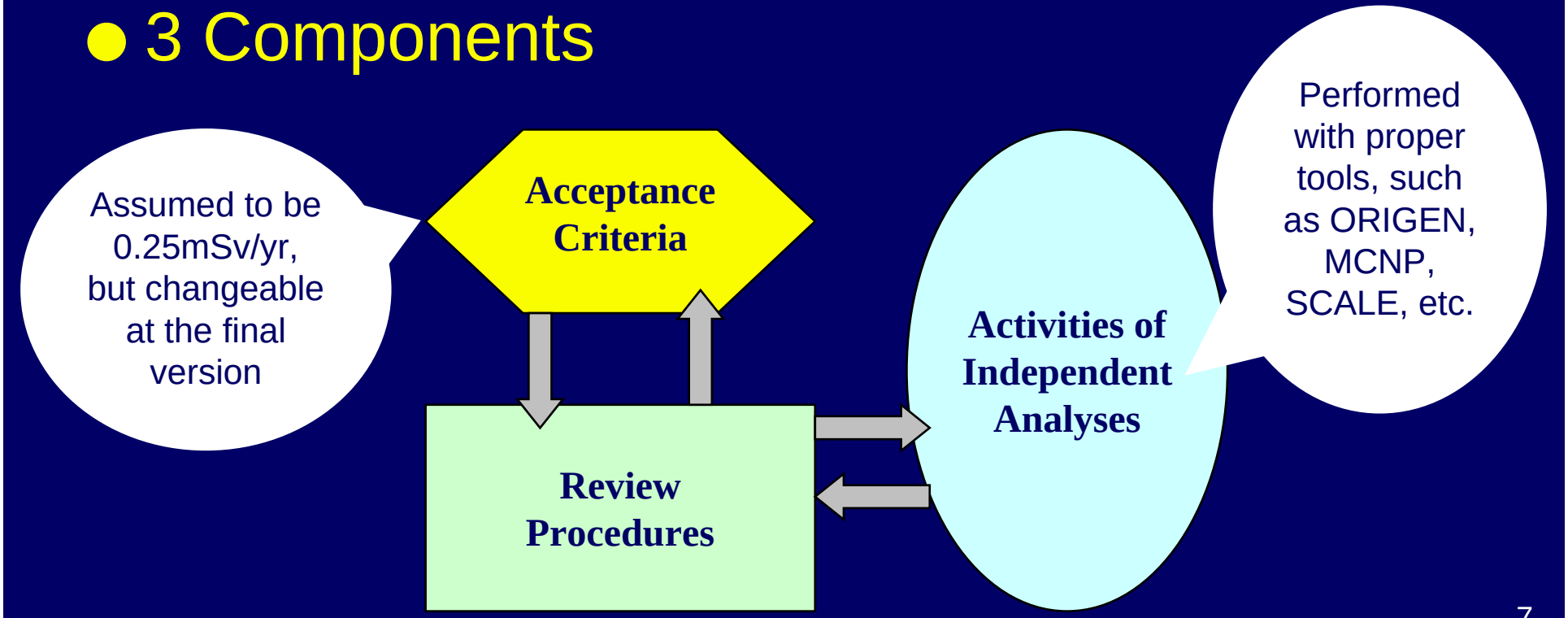


1.3 Projection of SNF Inventory upto 2020

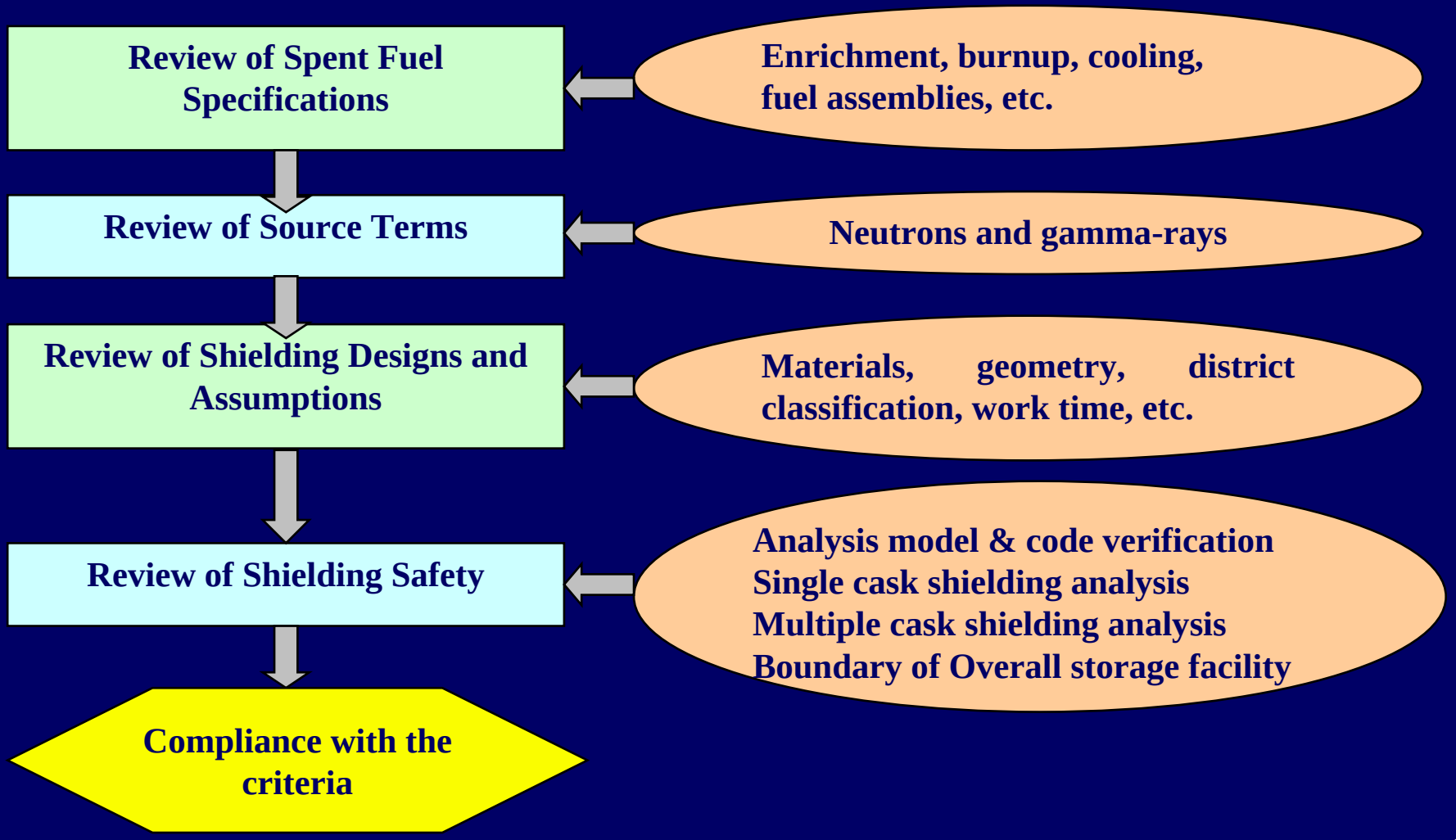


2. Review Framework for the Radiation shielding Safety

- Currently in the pre-conceptual development
  - Details of the interim storage not determined. So, the framework can be changed.
- 3 Components

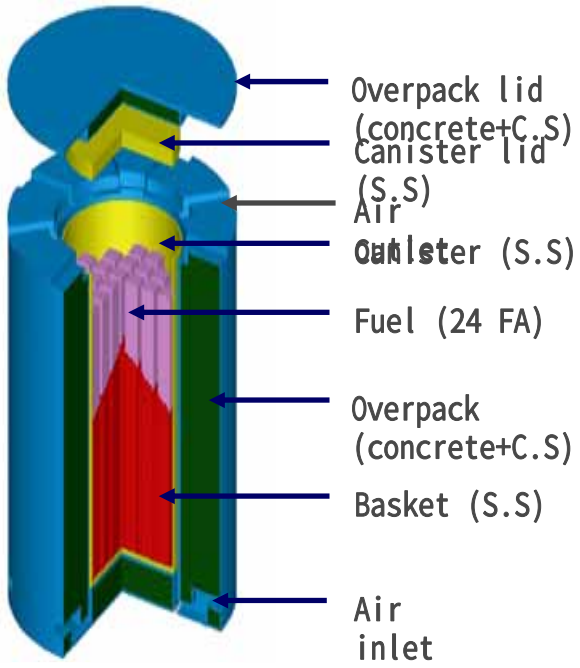


2.1 Review Procedures



3. Case Study

- Preliminary application to PWR spent fuel cask interim dry storage
  - » Review reference storage
    - 5 w/o U-235 enrichment
    - 50,000 MWD/MTU Burnup
    - 7 years of cooling
    - 24 fuel assemblies
  - » Source terms evaluation
    - ORIGEN-ARP (SCALE 5.0)
  - » Shielding analysis
    - SAS 4 (SCALE 5.0) & QAD-CGGP-A



Conceptual Drawing

3.1 Source Terms

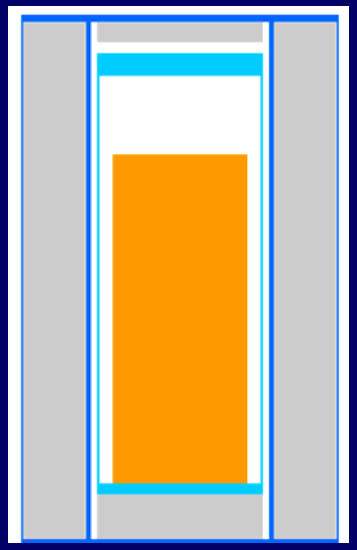
- Photons & Neutrons
  - » Spectrums & Intensities
    - ORIGEN-ARP code

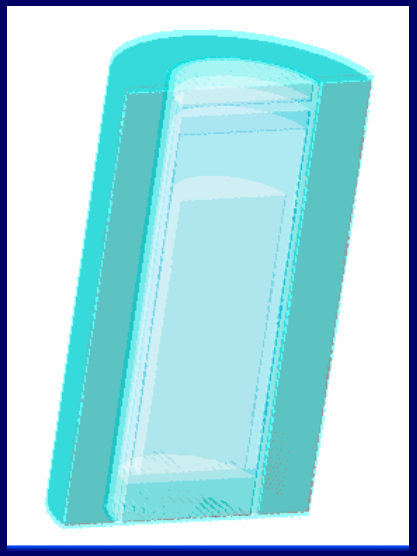
group	upper energy	lower energy	photon (#/sec)
1	1.00E+01	8.00E+00	4.91E+06
2	8.00E+00	6.50E+00	2.31E+07
3	6.50E+00	5.00E+00	1.18E+08
4	5.00E+00	4.00E+00	2.94E+08
5	4.00E+00	3.00E+00	7.00E+11
6	3.00E+00	2.50E+00	7.68E+12
7	2.50E+00	2.00E+00	3.13E+14
8	2.00E+00	1.66E+00	1.09E+14
9	1.66E+00	1.33E+00	1.54E+15
10	1.33E+00	1.00E+00	4.09E+15
11	1.00E+00	8.00E-01	1.74E+16
12	8.00E-01	6.00E-01	9.18E+16
13	6.00E-01	4.00E-01	4.37E+16
14	4.00E-01	3.00E-01	4.25E+15
15	3.00E-01	2.00E-01	5.74E+15
16	2.00E-01	1.00E-01	2.13E+16
17	1.00E-01	5.00E-02	2.35E+16
18	5.00E-02	1.00E-02	7.61E+16
		Totals	2.90E+17

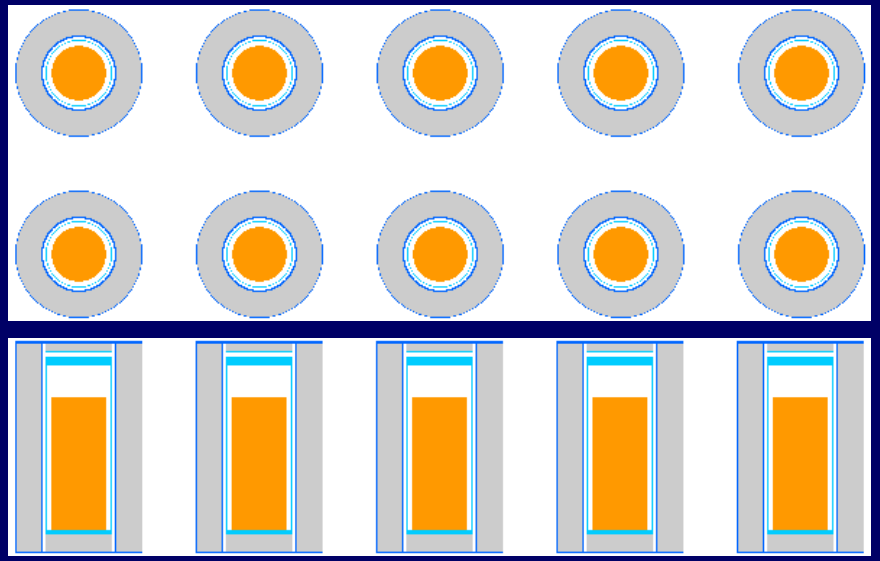
group	upper energy	lower energy	neutron (#/sec)
1	2.00E+01	6.43E+00	1.47E+08
2	6.43E+00	3.00E+00	1.55E+09
3	3.00E+00	1.85E+00	1.72E+09
4	1.85E+00	1.40E+00	9.16E+08
5	1.40E+00	9.00E-01	1.14E+09
6	9.00E-01	4.00E-01	1.15E+09
7	4.00E-01	1.00E-01	5.26E+08
8	1.00E-01	1.70E-02	7.75E+07
9	1.70E-02	3.00E-03	5.55E+06
10	3.00E-03	5.50E-04	4.11E+05
11	5.50E-04	1.00E-04	3.23E+04
12	1.00E-04	3.00E-05	2.27E+03
13	3.00E-05	1.00E-05	3.59E+02
14	1.00E-05	3.05E-06	7.11E+01
15	3.05E-06	1.77E-06	8.03E+00
16	1.77E-06	1.30E-06	2.36E+00
17	1.30E-06	1.13E-06	7.60E-01
18	1.13E-06	1.00E-06	5.44E-01
19	1.00E-06	8.00E-07	7.70E-01
20	8.00E-07	4.00E-07	1.25E+00
21	4.00E-07	3.25E-07	1.83E-01
22	3.25E-07	2.25E-07	2.13E-01
23	2.25E-07	1.00E-07	2.03E-01
24	1.00E-07	5.00E-08	5.52E-02
25	5.00E-08	3.00E-08	1.62E-02
26	3.00E-08	1.00E-08	1.14E-02
27	1.00E-08	1.00E-11	2.75E-03
		Total	7.23E+09

3.2 Shielding Analysis

- Geometry Modeling
  - » Homogenization and Simplification
    - Single cask modeling
    - Multi casks (an array of 2 x 5 casks)



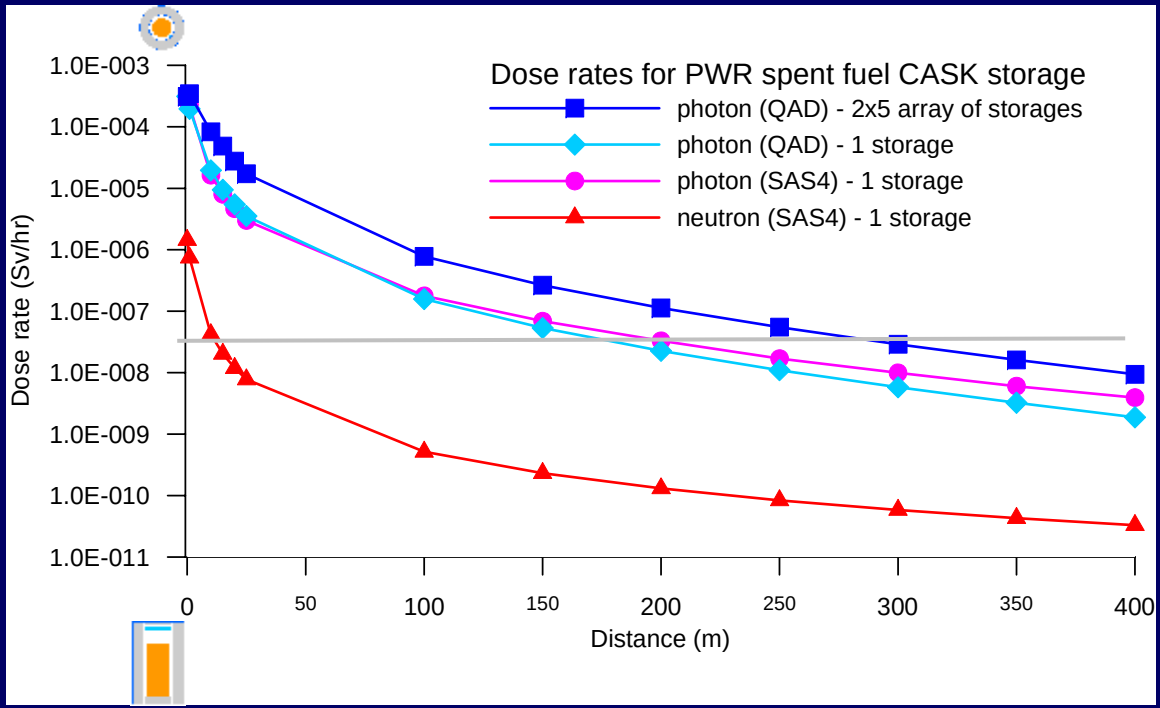




- Dose Conversion Factor
  - ANSI/ANS-6.1.1-1977

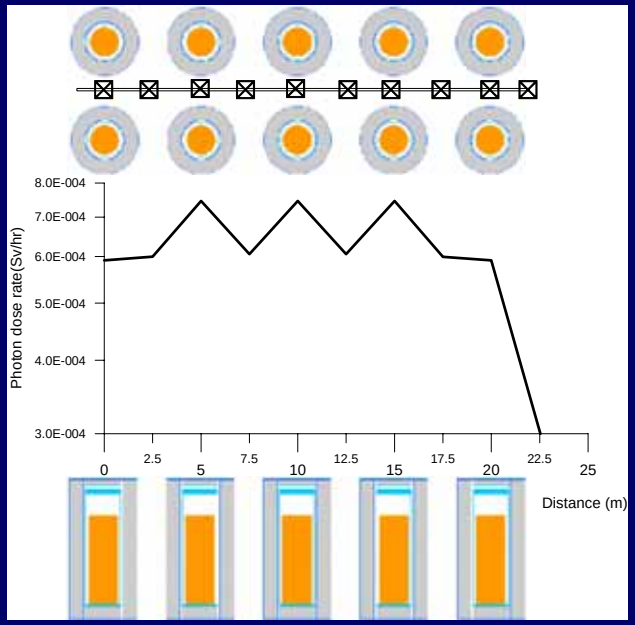
3.3 Preliminary Calculation

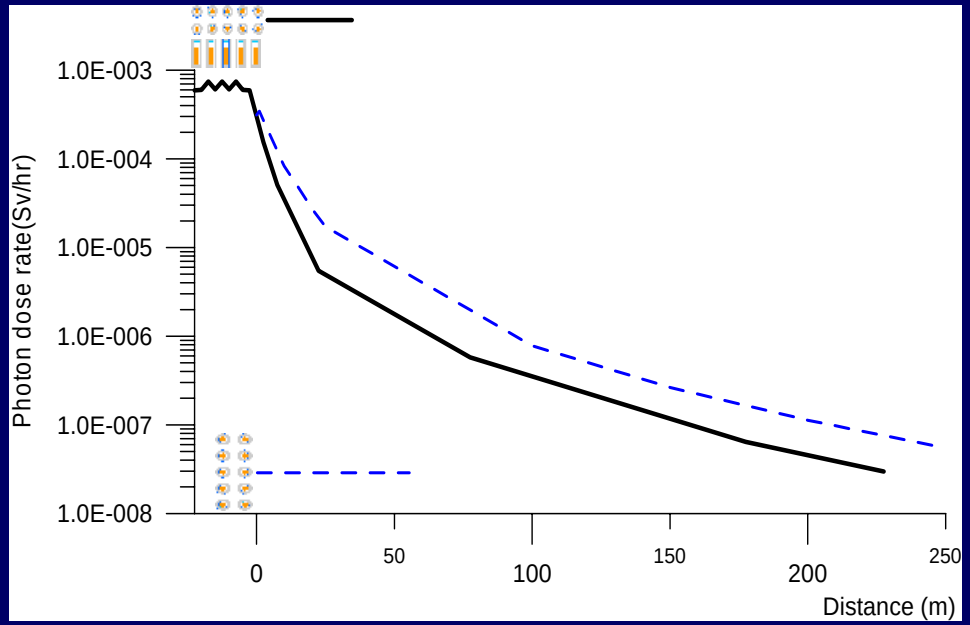
- Dose rates due to the direct radiation
  - Compliance with the acceptance criteria [0.25mSv/yr]
    - around 200 meters (single cask), 300 meters (2x5 casks)
      - At the final, radioactive effluents will be considered



3.3 Preliminary Calculation

- Photon dose rates for the array (QAD-CGGP-A)
  - Within the array
    - Distribution of photon dose rates
  - With the distances
    - Different with the direction of the array





4. Conclusion

- Review framework for the shielding safety
  - » Pre-conceptual structure developed
  - » Preliminary analyses performed
    - Review reference modeling, source terms, photon dose rates
  - » Further study will be continued to cover the missed issues
    - neutron streaming, Co-60 gammas, radioactive effluents, etc.
  - » Expected to satisfy the regulatory demand in the near future for the interim storage in Korea

Thank You ^^