Consequences of Spent Fuel Pool Accident due to Long Term Black Out at VVER-1200

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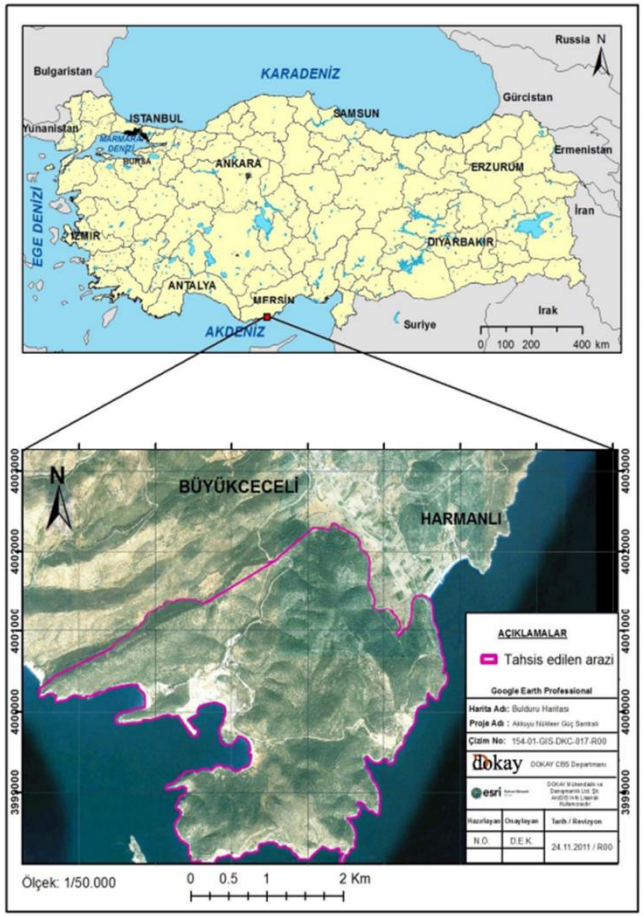
INTRODUCTION

- IGA between Turkish Republic and Russian Federation
- 4 units of VVER 1200 type NPP
- Mersin, Akkuyu Site
- Study case, similar to Fukushima Daiichi Accident



INVENTORY CALCULATIONS

- ORIGEN software
- Typical AES 2006 design
  - Burn up: 55.5 MWday/kg U
  - Average fuel enrichment: 4.79 %
  - Thermal Power: 3200 MWth
  - Number of fuel assemblies in core: 163
  - Number of refueled assemblies per year: 42
  - Duration of fuel in core : 4 years
  - Capacity of the spent fuel pool: spent fuel stored for 10 years + all the fuel in the core

INVENTORY CALCULATIONS

- Cladding failure: Pool saturation + Boil off = 2.29 days
- The storage period of the fuel in the spent fuel pool is used in inventory calculations. Additionally, spent fuel cladding failure period which is 2.29 days is also taken into account for spent fuel inventory calculations.

SOURCE TERM CALCULATIONS

- Release ratios are taken from NRC NUREG 1150

Isotope groups and release ratios

Groups	Release Ratio
Noble Gas Group (Xe, Kr)	0.95
Halogen Group (I)	0.35
Alkali Metal Group (Cs, Rb)	0.25
Tellurium Group (Te, Se, Sb)	0.15
Barium Group (Ba)	0.04
Strontium Group (Sr)	0.03
Cerium Group (Ce, Pu, Np)	0.01
Rutenium Group (Ru, Co, Rh, Pd, Mo, Tc,)	0.008
Lanthanum Group (La, Zr, Nd, Eu, Nb, Pm, Pr, Sm, Am, Cm, Y)	0.002

SOURCE TERM CALCULATIONS

Source Term with most significant fission products

Isotope	Activity (Bq)	Isotope	Activity (Bq)
Kr85	1.04E+17	**Sr89**	9.15E+16
Kr85m	4.72E+12	**Sr90**	2.92E+16
Kr87	3.94E-01	**Sr91**	4.32E+14
Kr88	1.10E+10	**Ce141**	5.01E+16
Xe133	4.73E+18	**Ce144**	4.62E+16
I133	1.71E+17	**Np239**	2.20E+17
I134	8.65E-09	**Ru103**	3.64E+16
Cs137	3.43E+17	**Mo99**	2.08E+16
Ba140	1.90E+17	**Y91**	8.02E+15

ATMOSPHERIC DISPERSION CALCULATIONS

- PC COSYMA software - Gaussian plume model
- Assumptions
  - Release height – 100 m
  - Day time
  - Summer season
  - Total dose was incurred in two days
- For 15 different atmospheric conditions

ATMOSPHERIC DISPERSION CALCULATIONS

Atmospheric conditions which were taken into consideration

Condition	Stability Class	Wind Speed	Condition	Stability Class	Wind Speed
1	A	1 m/s	**9**	C	7 m/s
2	A	2 m/s	**10**	D	4 m/s
3	B	1 m/s	**11**	D	6 m/s
4	B	2 m/s	**12**	D	7 m/s
5	B	4 m/s	**13**	E	2 m/s
6	C	2 m/s	**14**	E	4 m/s
7	C	4 m/s	**15**	F	2 m/s
8	C	6 m/s			

RESULTS

Conditions	Stability Class	Wind Speed (m/s)	Effective dose at 5 km (mSv)	Effective dose at 10 km (mSv)	Effective dose at 15 km (mSv)	Effective dose at 20 km (mSv)
1	A	1	4.39	1.81	1.32	0.90
2	A	2	2.54	0.97	0.74	0.52
3	B	1	5.51	2.29	1.54	1.10
4	B	2	3.25	1.29	0.89	0.65
5	B	4	1.73	0.71	0.49	0.37
6	C	2	4.75	1.81	1.27	0.88
7	C	4	2.61	1.03	0.72	0.51
8	C	6	1.80	0.73	0.52	0.36
9	C	7	1.56	0.64	0.46	0.32
10	D	4	4.18	1.43	0.99	0.71
11	D	6	2.88	1.02	0.73	0.52
12	D	7	2.50	0.89	0.64	0.47
13	E	2	15.18	4.22	2.95	2.02
14	E	4	8.49	2.43	1.69	1.21
15	F	2	37.84	8.09	4.70	2.94

CONCLUSIONS

- Annual dose limit for the public is not foreseen to be exceeded beyond 20 km except for the stability classes E and F and wind speeds of 2-4 m/s.
- According to IAEA GS-R-2 requirements document, the generic intervention level for sheltering is avertable dose of 10 mSv in a period of no more than 2 days. It is stated in the document that authorities may wish to advise sheltering at lower intervention levels for shorter periods or so as to facilitate further countermeasures, e.g. evacuation.
- So sheltering may required to be implemented within 5 km.

Thank You