Tabletop Exercises: Risk Informed Technical Specifications

Application to the U.S.EPR

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Assumptions

- Internal events at power
- Point estimates CDF values
- Truncation Value at 1E-20 absolute and 1E-06 relative
- All preventive and corrective maintenance set to false
- Current EPR Technical Specification AOT=120 days longer than the NEI proposed Backstop of 30 days
- Backstops considered 30, 120 and180 days

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U.S.EPR Safety Functions

- The U.S. EPR design incorporates four trains of most safety systems
- Four trains of safety injection systems (LHSI, MHSI, and accumulators)
- Four trains of emergency Feedwater (EFW) supplying four steam generators. Each train has an EFW water storage tank for its suction source.
- Four safety trains of support systems (cooling trains, building HVAC, and electric power).
- 4 Safety Emergency Diesel Generators (EDG) & 2 non-safety Station Blackout Diesel Generators (SBO)

U.S.EPR Trains Configuration

Train 1	Train 2	Train 3	Train 4
EDG 10	EDG 20	EDG 30	EDG 40
SBO 50			SBO 80
EFW 1, LHSI 1, MHSI 1	EFW 2, LHSI 2, MHSI 2	EFW 3, LHSI 3, MHSI 3	EFW 4, LHSI 4, MHSI 4
			SAHR

Cases Summary (1/2)

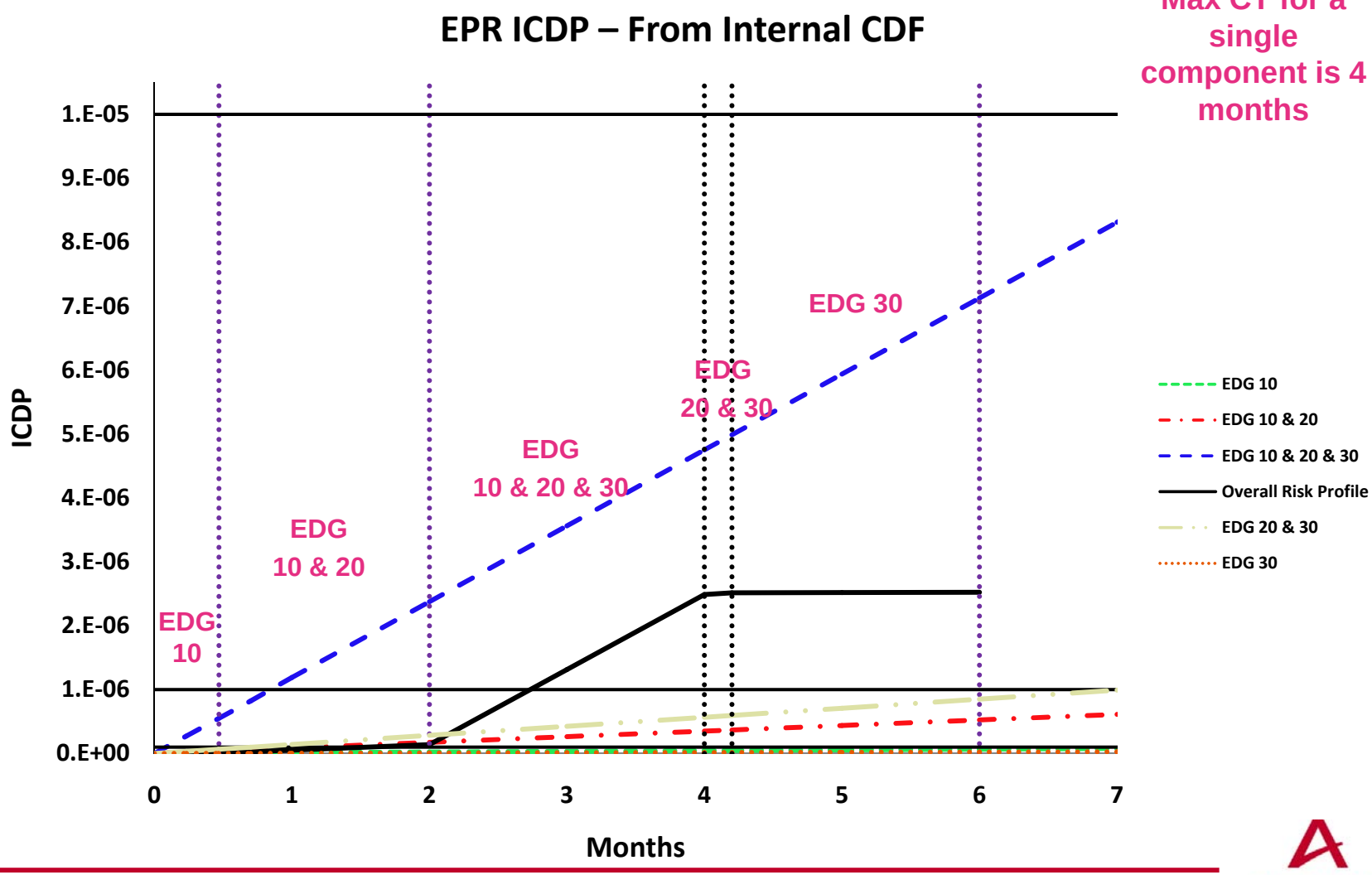
Plant Configuration	Case Number	Case Definition	CDF (1/yr)	ICDF (1/yr)	Allowed CT for ICDP 1E-5 (Days)	Allowed CT for ICDP 1E-6 (Days)	ICDP for 30 Days	ICDP for 120 Days	ICDP for 180 Days	Available Backup Trains
1	**Case 00**	EDG 10	2.9E-07	1.3E-07	27221	2722	1.1E-08	4.4E-08	6.6E-08	3 EDG, 2 SBO EDG
	Case 01	EDG 10 & 20	1.2E-06	1.0E-06	3480	348	8.6E-08	3.4E-07	5.2E-07	2 EDG, 2 SBO EDG
	Case 02	EDG 10, 20 & 30	1.4E-05	1.4E-05	256	26	1.2E-06	4.7E-06	7.0E-06	1 EDG, 2 SBO EDG
2	**Case 00**	EDG 10	2.9E-07	1.3E-07	27221	2722	1.1E-08	4.4E-08	6.6E-08	3 EDG, 2 SBO EDG
	Case 03	EDG 10 & SBO 50	6.1E-07	4.6E-07	7969	797	3.8E-08	1.5E-07	2.3E-07	3 EDG, 1 SBO EDG
	Case 05	EDG 10, SBO 50 & 80	3.3E-06	3.1E-06	1163	116	2.6E-07	1.0E-06	1.5E-06	3 EDG
3	**Case 00**	EDG 10	2.9E-07	1.3E-07	27221	2722	1.1E-08	4.4E-08	6.6E-08	3 EDG, 2 SBO EDG
	Case 06	EDG 10 & 20, SBO 50 & 80	2.2E-05	2.2E-05	165	16	1.8E-06	7.3E-06	1.1E-05	2 EDG
	Case 07	EDG 10 & 40, SBO 50 & 80	2.6E-05	2.6E-05	143	14	2.1E-06	8.4E-06	1.3E-05	2 EDG
4	**Case 00 D**	MHSI 1	2.0E-07	4.4E-08	82218	8222	3.6E-09	1.5E-08	2.2E-08	3 MHSI
	Case 08	MHSI 1 & LHSI 1	2.2E-07	6.4E-08	57031	5703	5.3E-09	2.1E-08	3.2E-08	3 MHSI, 3 LHSI
	Case 10	MHSI 1 & 2, LHSI 1	5.2E-07	3.7E-07	9786	979	3.1E-08	1.2E-07	1.8E-07	2 MHSI, 3 LHSI

Cases Summary (2/2)

Plant Configuration	Case Number	Case Definition	CDF (1/yr)	ICDF (1/yr)	Allowed CT for ICDP 1E-5 (Days)	Allowed CT for ICDP 1E-6 (Days)	ICDP for 30 Days	ICDP for 120 Days	ICDP for 180 Days	Available Backup Trains
5	**Case 00**	EDG 10	2.9E-07	1.3E-07	27221	2722	1.1E-08	4.4E-08	6.6E-08	3 EDG, 2 SBO EDG
	Case 12	EDG 10 & LHSI 3	4.5E-07	3.0E-07	12373	1237	2.4E-08	9.7E-08	1.5E-07	3 EDG, 2 SBO EDG, 3 LHSI
	Case 13	EDG 10 & LHSI 3 & MHSI 4	6.5E-07	5.0E-07	7329	733	4.1E-08	1.6E-07	2.5E-07	3 EDG, 2 SBO EDG, 3 LHSI, 3 MHSI
6	**Case 01**	EDG 10 & 20	1.2E-06	1.0E-06	3480	348	8.6E-08	3.4E-07	5.2E-07	2 EDG, 2 SBO EDG
	Case 15	EDG 10 & 20 & LHSI 3	4.0E-06	3.8E-06	953	95	3.1E-07	1.3E-06	1.9E-06	2 EDG, 2 SBO EDG, 3 LHSI
	Case 16	EDG 10 & 20 & LHSI 3 & MHSI 4	7.2E-06	7.0E-06	518	52	5.8E-07	2.3E-06	3.5E-06	2 EDG, 2 SBO EDG, 3 LHSI, 3 MHSI
7	**Case 00**	EDG 10	2.9E-07	1.3E-07	27221	2722	1.1E-08	4.4E-08	6.6E-08	3 EDG, 2 SBO EDG
	Case 17	EDG10 & EFW 1	5.4E-07	3.9E-07	9311	931	3.2E-08	1.3E-07	1.9E-07	3 EDG, 2 SBO EDG, 3 EFW
	Case 18	EDG 10 & EFW 1 & LHSI 4	6.5E-07	5.0E-07	7300	730	4.1E-08	1.6E-07	2.5E-07	3 EDG, 2 SBO EDG, 3 EFW, 3 LHSI
8	**Case 20**	EDG 20 & 30, EFW 10 & 40	7.4E-05	7.4E-05	49	5	6.1E-06	2.4E-05	3.6E-05	2 EDG, 2 EFW
	Case 21	EDG 20 & 30, EFW 10 & 40, LHSI 40	1.5E-04	1.5E-04	24	2	1.2E-05	5.0E-05	7.4E-05	2 EDG, 2 EFW, 3 LHSI
9		ALL TRAIN 2 MAINTENANCE	2.9E-07	1.4E-07	25524	2552	1.2E-08	4.7E-08	7.1E-08	CCW/ESW, DMWS, EDG, EFW, LHSI, MHSI, SAC/QKA
10	**Case 22**	All LHSI trains and 1 EDG	3.9E-05	3.9E-05	93	9	3.2E-06	1.3E-05	1.9E-05	4 MHSI & 1 SAHR, 3 EDG

Configuration 1

Assumption:
Max CT for a single component is 4 months



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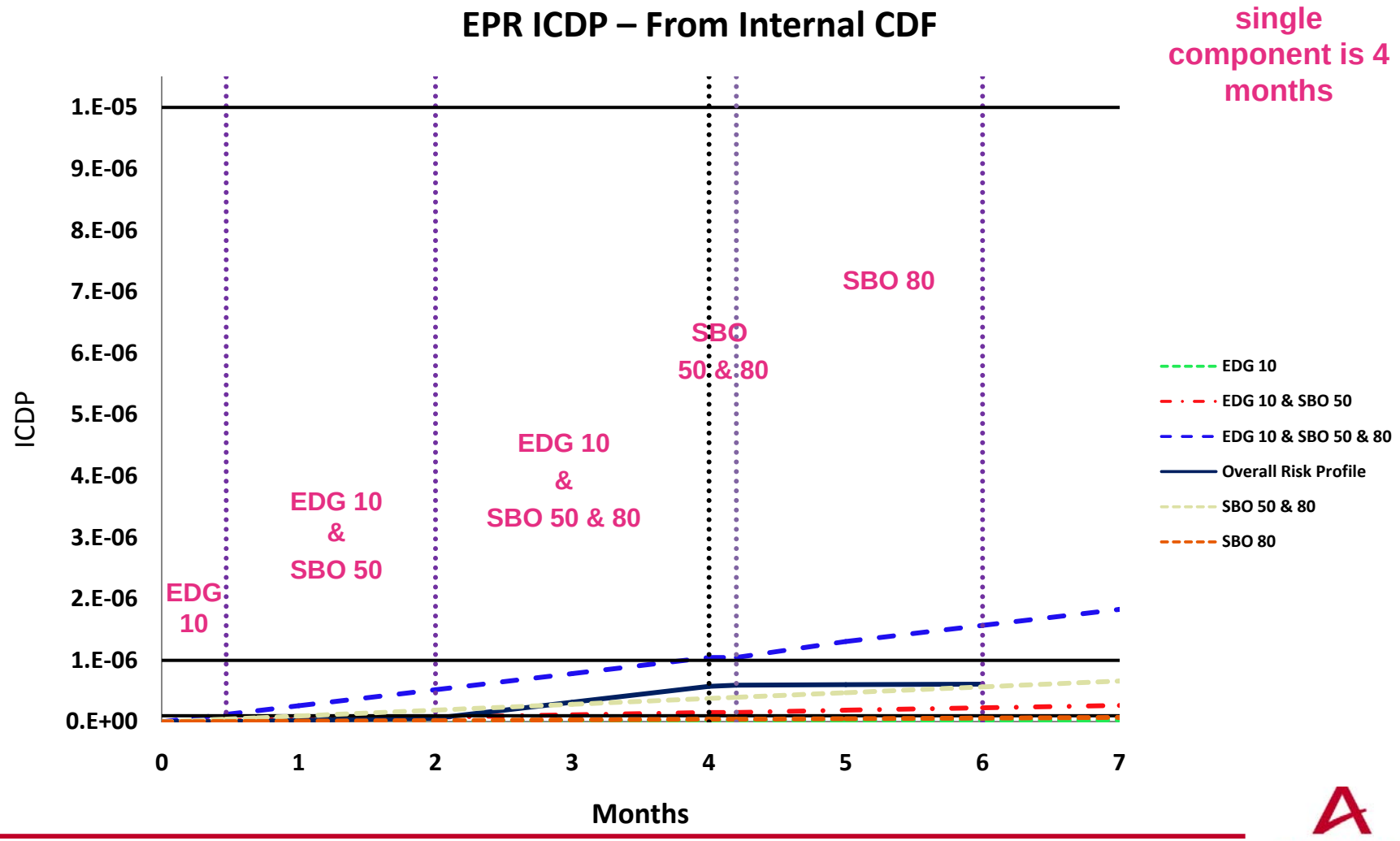
Configuration 2

Assumption:
Max CT for a single component is 4 months



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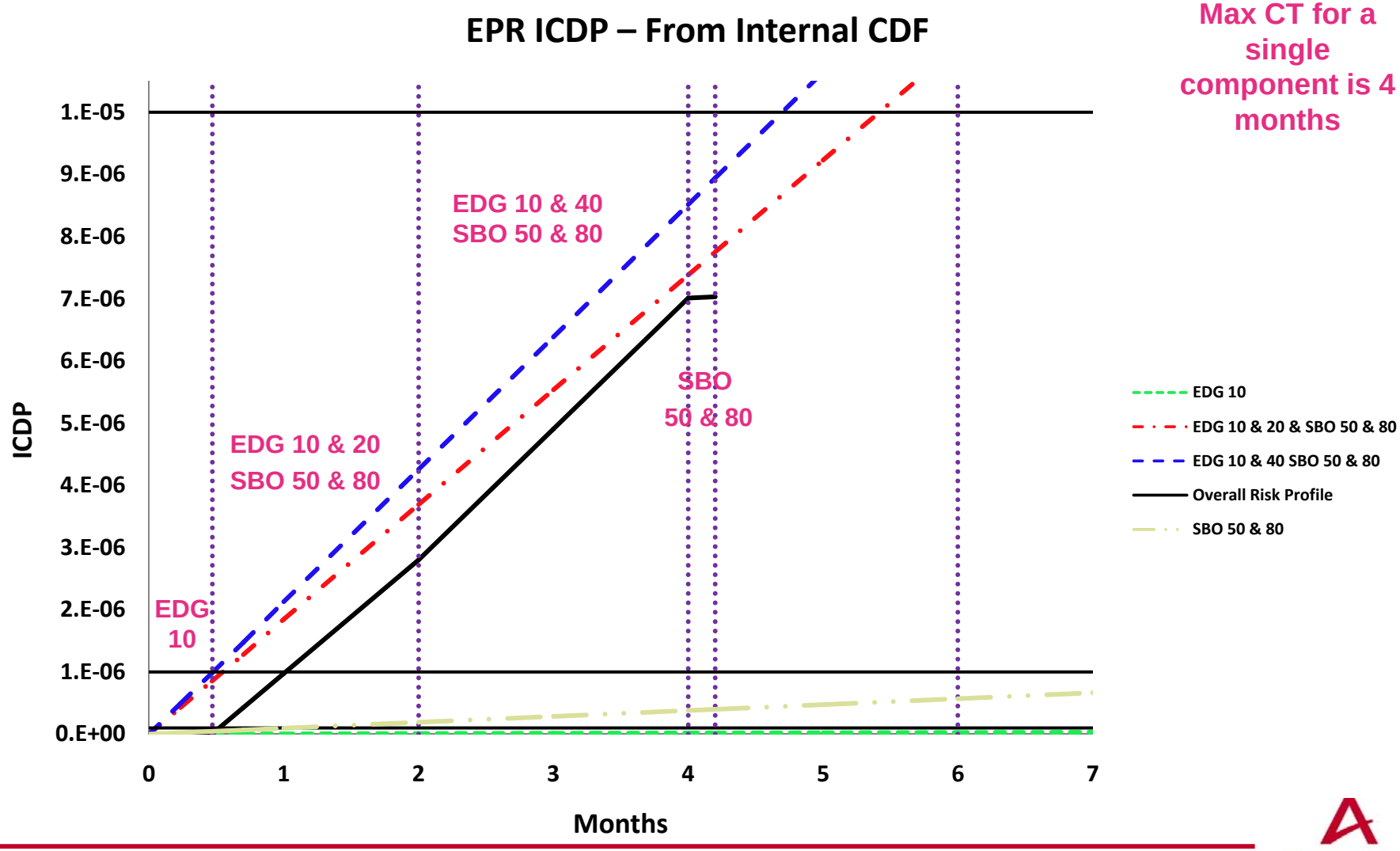
Configuration 3

Assumption:
Max CT for a single component is 4 months



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Additional Slides

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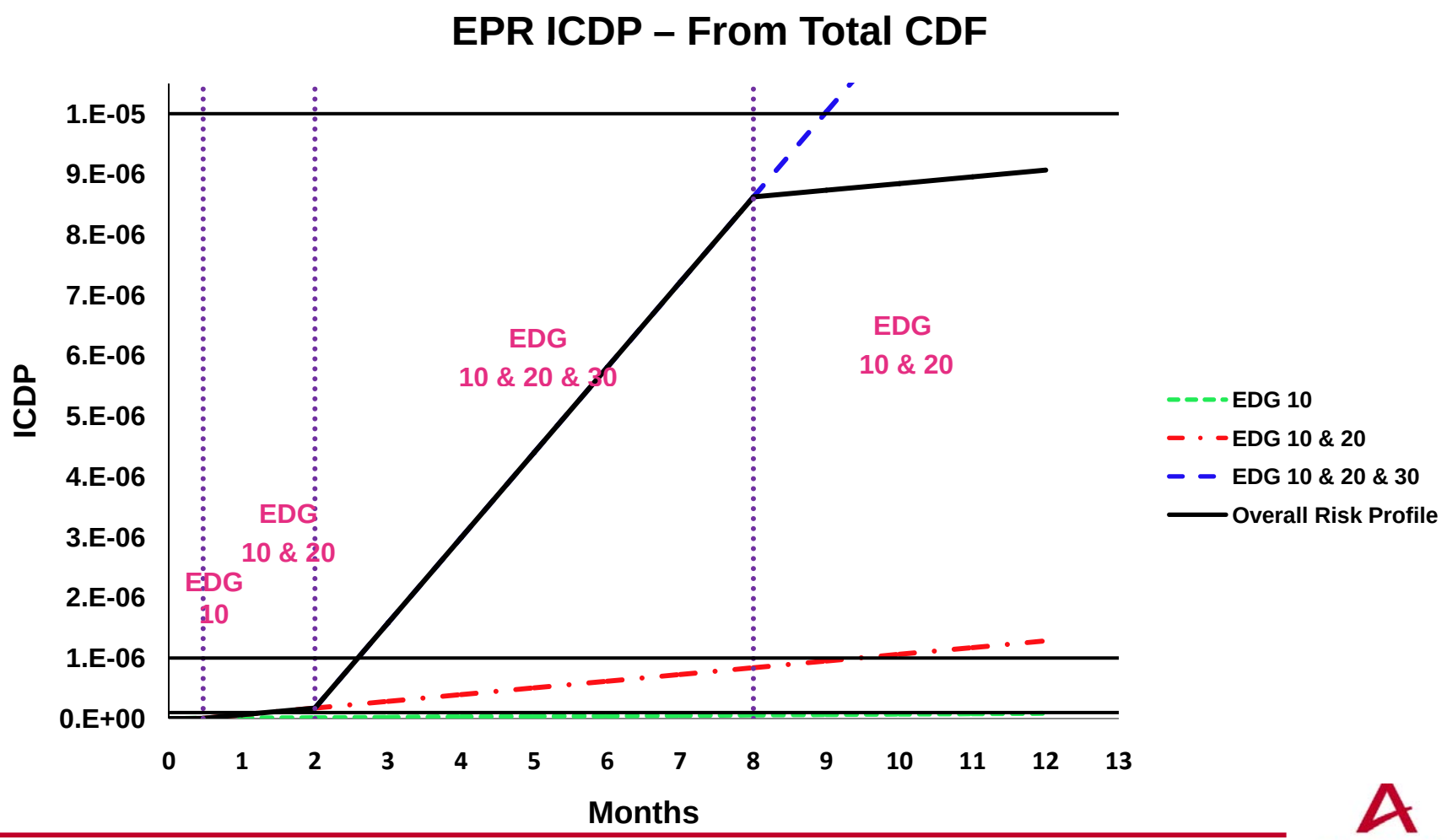
Configuration 1



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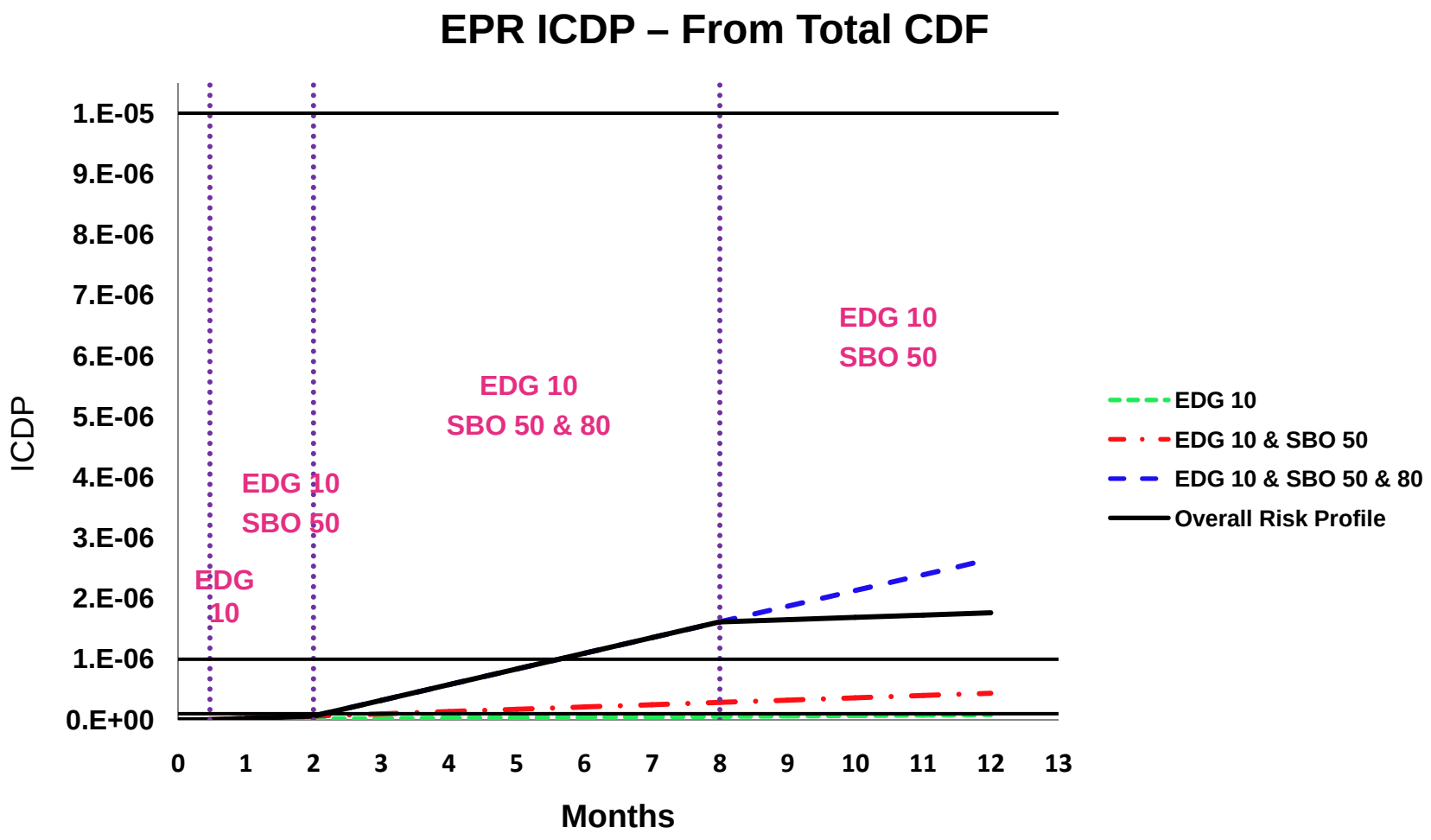
Configuration 2



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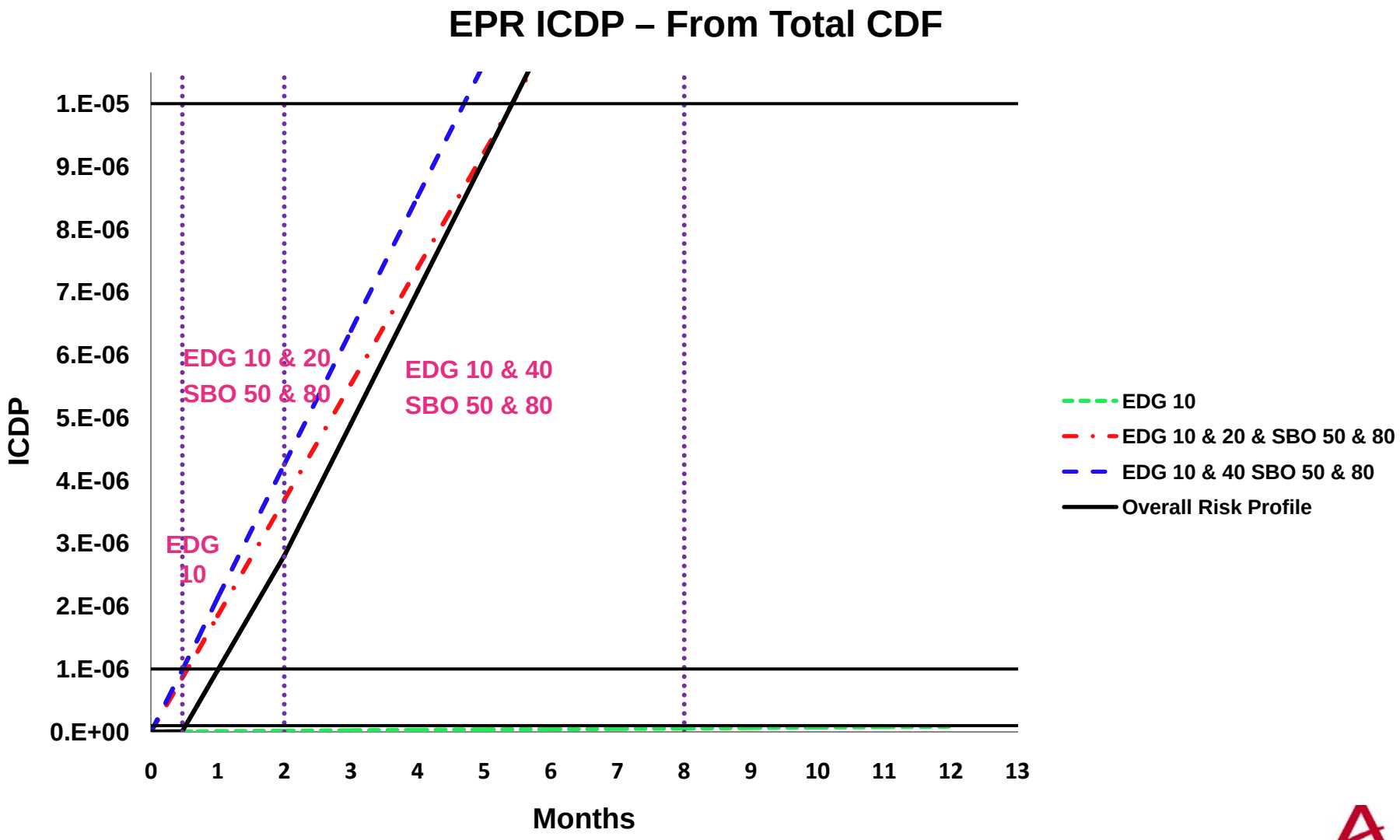
Configuration 3



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Quantification of Risk Related to RI AOT

Component X Risk Increase (1/yr)= [CDF (Component X Deterministic AOT) – CDF (Component X RI AOT)]
Risk Increase = [Component X RAW-1] * CDF (Component X Deterministic AOT) * [Component X AOT]

- **Per RG 1.177, each component can have a RI AOT based on an individual risk increase ICCDP< 5E-7**
- **The overall risk impact should be a delta CDF<1E-6/yr per RG 1.174 and is calculated as follows:**
  - **A new AOT is evaluated for each component based on a risk increase ICCDP < 5E-7**
  - **Each component maintenance unavailability = 0.1 RI AOT+ PM**
  - **No simultaneous maintenance on different divisions allowed**
  - **The total CDF (internal, fire and flood) is evaluated**
- **Alternative RI AOTs were evaluated based on a modified risk increase threshold of ICCDP<1E-7**

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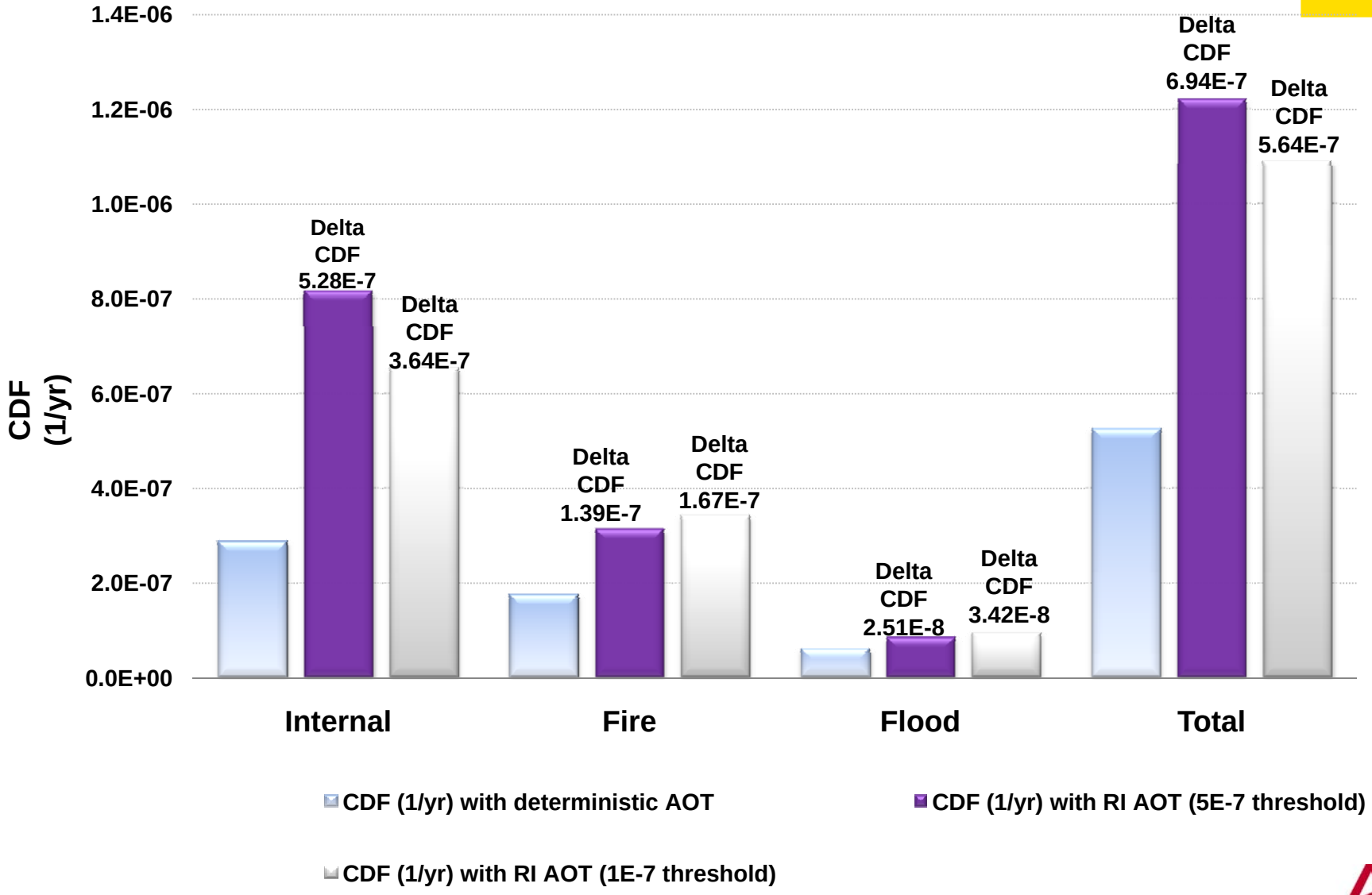
CDF Comparison with current AOTs and Risk Informed AOTs



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Summary

- **Initiative 4b:**
  - **ICDP > 1E-5 in 30 days only for case 21 with systems from 3 divisions out and secondary heat removal and F&B impacted**
  - **For all other cases ICDP=1E-5 reached with CT longer than 30 days**
  - **Configuration 9 with all train 2 systems in maintenance, ICDP<< 1E-5**
- **RI AOT (RG 1.177 & RG 1.174)**
  - **Total risk increase Delta CDF < 1E-6/yr**
  - **RI AOTs longer than current AOTs except for HVAC**