CMD 15-H8.10B

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Supplementary Information

Renseignements supplémentaires

Oral presentation

Exposé oral

Presentation from Greenpeace

Présentation de Greenpeace

In the Matter of

À l'égard de

Ontario Power Generation Inc.

Ontario Power Generation Inc.

Application to renew the Power Reactor Operating licence for the Darlington Nuclear Generating Station

Demande concernant le renouvellement du permis d'exploitation pour la centrale nucléaire de Darlington

Commission Public Hearing
Part 2

Audience publique de la Commission
Partie 2

November 2-5, 2015

2-5 novembre 2015

FORESIGHT & SITING:

The Darlington nuclear station and unreasonable risks to Toronto and the environment

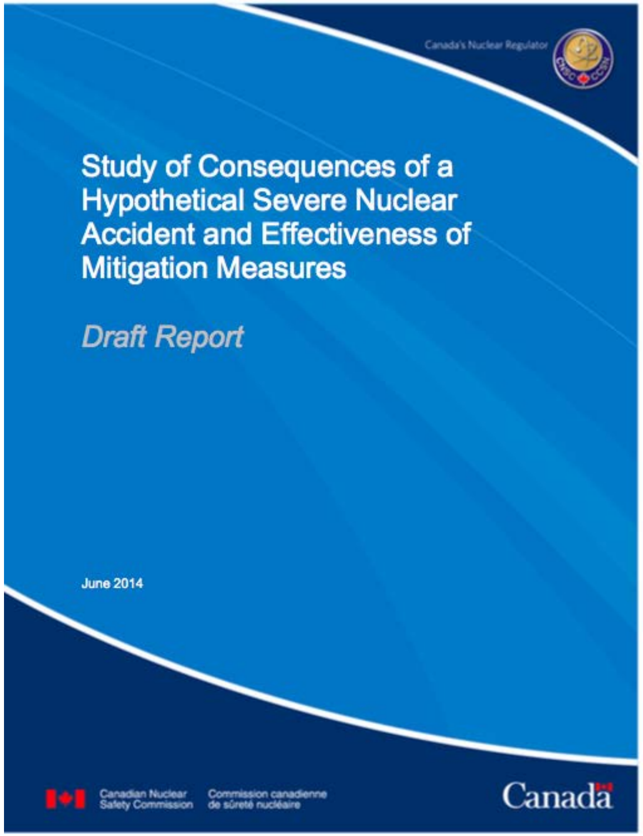
Shawn-Patrick Stensil
Greenpeace Canada

November 2015

GREENPEACE

www.greenpeace.ca

Risking Toronto & The Environment



"The three bears paradigm…": "not too small, not too large; just right."
OPG Justification for Original SARP scenarios

I have taken a quick look at the draft submitted; indeed, this will become a focal point of any licence renewal, and despite brilliant attempts to caution readers, this document would be used malevolent-ly [sic] in a public hearing. It's a no-win proposition whatever whatever [sic] we think the Commission requested.
Justification for removing level 7 INES accidents from public study.

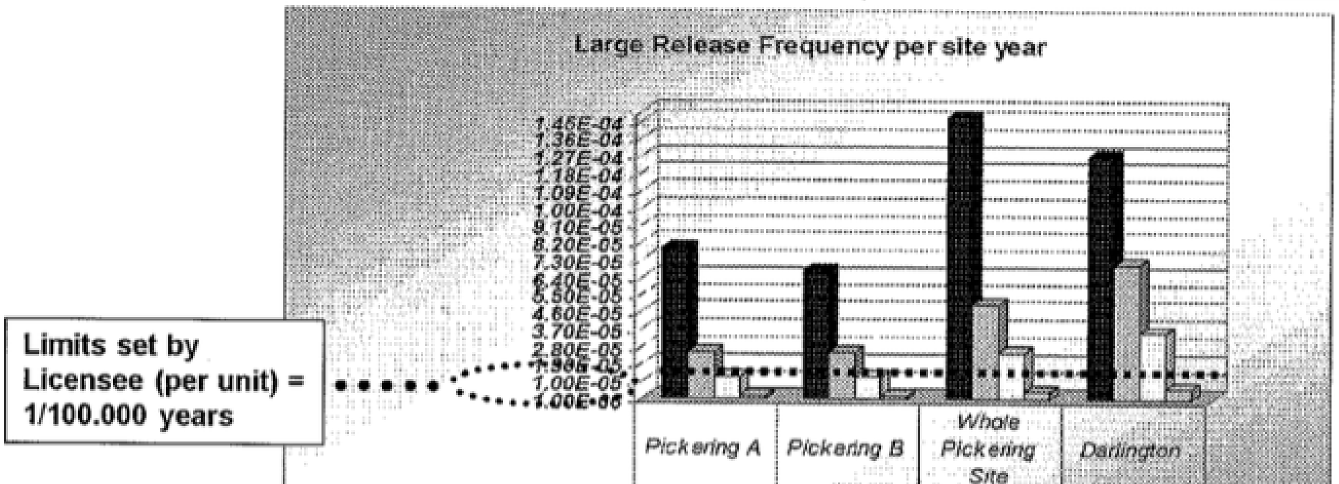
No evidence demonstrating adequacy of last level of defense-in-depth

Site Wide Risk: Greenpeace Concern Validated

	Frequency	LRF limit for New Reactors	OPG's LRF Risk Limit
LRF 2014 Simple Multiplication(1)	1.27E-04	1E-6	1E-5
LRF 2014 Enhanced without EME	7.16E-05		
LRF 2014 EME 50% Efficiency	3.58E-05		
LRF 2014 EME 90% Efficiency	7.16E-06		
CNSC 2015 LRF with EME(2)	1.31E-05		
CNSC 2015 LRF with EME & SIOs	7.40E-06		
OPG 2015 with EME	0.98E-05		
OPG 2015 with EME & SIOs	7.40E-06		

Site-wide risk is at least 10 times higher than limit for new reactors

Risk Aggregation for Multi-unit Sites
LRF Whole-Site Aggregation

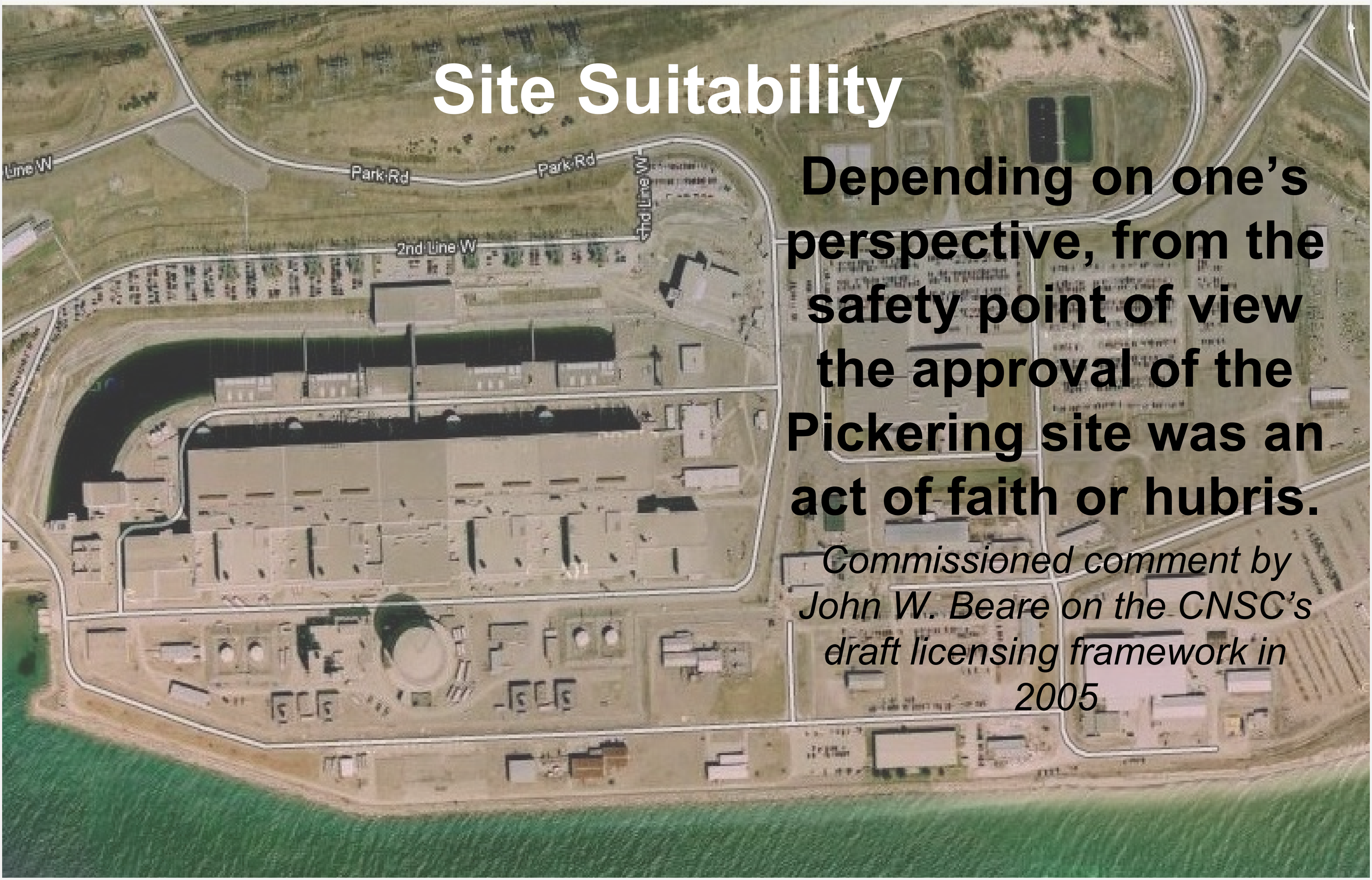


	Pickering A	Pickering B	Whole Pickering Site	Darlington
Simple Multiplication	7.95E-05	6.80E-05	1.48E-04	1.27E-04
Enhanced w-o EME	2.53E-05	2.53E-05	5.07E-05	7.16E-05
EME 50% efficiency	1.27E-05	1.27E-05	2.53E-05	3.58E-05
EME 90% efficiency	2.53E-06	2.53E-06	5.07E-06	7.16E-06

CNSC staff internally admit site-wide risk may be “unreasonable” under the Nuclear Safety and Control Act.

Accident Sequence	Origin of radioactive releases	I-131	Cs-137	INES Level
Release Category 2 & Severe Accident Study Release.	• Proposed by OPG • Source term equivalent to lower threshold for large release under RD-337. • OPG used the same source term as reference accident in new build environmental assessment. • Equivalent to 0.0015% of core inventory of i-131	4.4E+15	1E+14	INES 6
SARP Multi-Unit Scenario	• Proposed by CNSC staff. • RC2 source term multiplied by four to imitate multi-unit accident at Darlington. • Equivalent release modeled in past. • Equivalent to 0.01% of core inventory of i-131	1.76E+16	4E+14	INES 6
Suppressed Severe Accident Study Release	• Originally proposed by OPG. • RC2 source term multiplied by 10. • Was removed from public report because staff feared citizens would use results “malevolently”. • Equivalent to 0.015% of core inventory of I-131	4.4E+16	1E+15	INES 7
Release Category 1	• Release of more than 3% of core inventory of I-131. • Twenty times larger than RC2 and CNSC’s lower threshold for a large release. • 98.8% of accident sequences are multi-unit.	8.76E+16	?	INES 7
Fukushima	• Release from 3 Reactors	1.6E+17	1.5E+16	INES 7
Chernobyl	• Single Unit Release	1.5E+18	6.2E+16	INES 7

Site Suitability



Depending on one's perspective, from the safety point of view the approval of the Pickering site was an act of faith or hubris.

Commissioned comment by John W. Beare on the CNSC's draft licensing framework in 2005

Balancing the Push for EMEs

"So there was a point where we were not satisfied with the numbers coming out of the PSA, in particular for fire and for wind. And in particular, you had sort of pushed -- the Commission had pushed very hard to implement within the PSA what's the EME benefit going to be of these new EMEs. ***And at the time, that was controversial with respect to nobody really knew how to do that very well.****"*

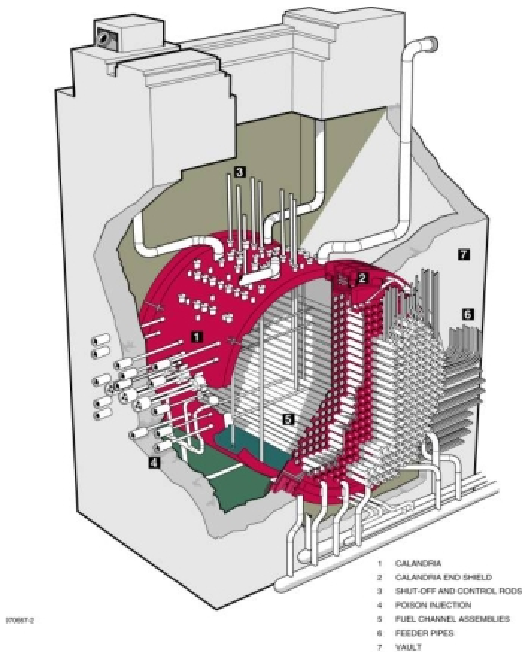
Gerry Frappier, August 2014

The need for an acceptable framework for EME credit and SAMG guidance in PSA was expressed. *This subject may need further discussion. The need for a holistic approach was also highlighted. The methods models should be simple enough to* ***be traceable and applicable****. It is also important to note that the PSA modelling is a function of its intended uses.*

Summary Report of the CNSC International Workshop on Multi-unit PSA, November 2014

Rushed implementation EMEs raise questions about RD-2.4.2 compliance & quality

Cost Benefit Analysis



CANDU 6 Reactor Assembly

En effet, selon les résultats des études préliminaires, la réfection de la centrale, en vue d'en prolonger la durée de vie utile jusqu'à l'horizon 2035, constitue, actuellement, l'option la plus avantageuse du point de vue économique pour continuer de fournir l'énergie produite par Gentilly-2. **Il faut toutefois noter que ces avantages économique sont faibles et dépendent de diverse hypothèses dont celles reliées aux exigences imposées par la CCSN**

Hydro-Quebec to the CNSC in 2005

Recommendation: The CNSC should require OPG to release the cost-benefit analysis used to justify the limited upgrades proposed for the Darlington life-extension

Summary and Recommendations

- The CNSC should not approve the life-extension of Darlington before it has received and publicly reviewed the planning basis for offsite nuclear emergency plans.

- The CNSC needs to publish INES 7 accident scenarios before the life-extension can be approved.

- The environmental review should be updated to acknowledge the "adverse effect" caused by the life-extension.

- The CNSC needs to consult and approve siting criteria before the life-extension is approved.

- The licensing basis for the station should be updated in light of Fukushima to include external events.

- Cost benefit should be reviewed before the life-extension is approved.

Recommendation: The Commission should reject OPG's request to rebuild Darlington and for a 13-year licence

Appendix

Table 5 – Variations in Darlington Large Release Frequency

	DARA 2012 (1)			DARA 2015 (2)	
Release Category	**Baseline Predicted Frequency**	**Enhanced Model with SIOs**	**Enhanced Model without SIOs**	**Baseline Predicted Frequency with EMEs**	**With EME and SIOs (3)**
D-RC1 (A level 7 INES accident with more the 3% of I-131 to the environment)	4.9E-06	5.1E-08	7.8E-07	5.0E-07	OPG would not provide. Greenpeace Estimate: 2E-7
D-RC2 (A level 6 INES accident with releases equivalent to the CNSC's severe accident study)	3.7E-07	3.6E-07	5.2E-07	5.2E-07	OPG would not provide. Greenpeace Estimate: 2E-7
D-RC3	0	0	0	0	0
Summed Frequency of Large Releases Categories	**5.27E-06**	**4.11E-07**	**1.3.6**	**1E-6**	**4E-7 (4)**

Darlington Risk Assessment (2011)

Table 3: Darlington NGS Level-2 At-power Internal Risk Events Risk Assessment Uncertainty by Release Category (Ref: NK38-REP-03611-10044)

Release Category	Point Estimate Frequency (/r-y)	Mean (/r-y)	5%	50%	95%	Error Factor[1]
RC1	4.88E-06	4.95E-06	6.95E-07	3.22E-06	1.29E-05	4.31
RC2	3.74E-07	3.66E-07	1.10E-08	9.27E-08	1.29E-06	10.83
RC4	1.99E-09	2.23E-09	0.00E+00	9.54E-11	5.57E-09	58.40[2]
RC7	1.45E-06	1.44E-06	1.54E-07	6.84E-07	4.09E-06	5.15
RC8	4.88E-06	4.94E-06	6.90E-07	3.21E-06	1.29E-05	4.32
LRF	5.24E-06	5.40E-06	8.58E-07	3.53E-06	1.42E-05	4.07

[1]Note: The error factor is calculated as follows: $\sqrt{\frac{CutSet(95\%)}{CutSet(5\%)}}$

[2]Note: For lognormal distributions, the error factor is equal to: $\frac{CutSet(95\%)}{CutSet(50\%)}$. For RC4 this equation is used

Note: Based on Containment Event Trees, no sequences are assigned to end states RC3/RC5/RC6. As there are no sequences assigned to these end states, the frequencies of RC3/RC5/RC6 are zero.

Pickering A Risk Assessment (2013)

Table 1: Pickering NGS 'A' Level-2 At-power Internal Risk Events Risk Assessment Uncertainty by Release Category (Ref: NA44-REP-03611-00013)

Release Category	Point Estimate Frequency (/r-y)	Mean (/r-y)	5%	50%	95%	Error Factor[1]
RC1	4.69E-06	4.81E-06	1.55E-06	3.46E-06	1.19E-05	2.77
RC3	3.45E-08	3.88E-08	0.00E+00	1.23E-08	1.41E-07	
RC4	3.38E-08	4.25E-08	8.64E-10	1.34E-08	1.57E-07	13.48
LRF	4.71E-06	4.84E-06	1.57E-06	3.48E-06	1.17E-05	2.73

[1]Note: The error factor is calculated as follows: $\sqrt{\frac{CutSet(95\%)}{CutSet(5\%)}}$

Note: Based on Containment Event Trees, no sequences are assigned to end states RC2/RC5. As there are no sequences assigned to these end states, the frequencies of RC2/RC5 are zero.

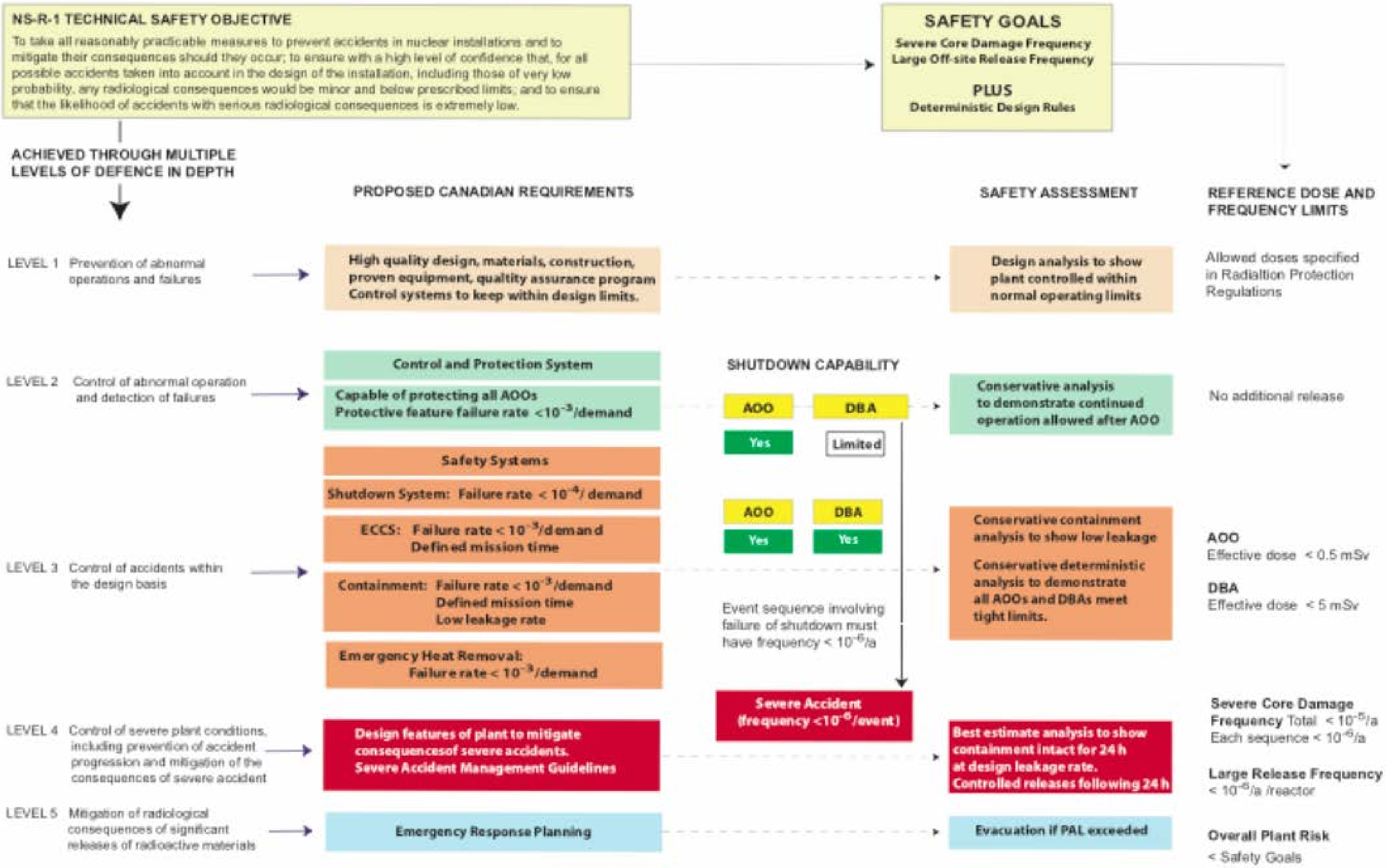
Pickering B Risk Assessment (2012)

Table 2: Pickering NGS 'B' Level-2 At-power Internal Risk Events Risk Assessment Uncertainty by Release Category (Ref: NK30-REP-03611-00010)

Release Category	Point Estimate Frequency (/r-y)	Mean (/r-y)	5%	50%	95%	Error Factor[1]
RC1	2.92E-06	2.88E-06	2.32E-07	8.38E-07	8.33E-06	5.99
RC3	9.66E-07	8.69E-07	1.74E-08	1.89E-07	2.74E-06	12.55
RC5	2.03E-07	2.12E-07	3.09E-09	3.70E-08	6.23E-07	14.20
LRF	3.88E-06	3.77E-06	3.24E-07	1.19E-06	1.09E-05	5.80

[1]Note: The error factor is calculated as follows: $\sqrt{\frac{CutSet(95\%)}{CutSet(5\%)}}$

Note: Based on Containment Event Trees, no sequences are assigned to end states RC2/RC4. As there are no sequences assigned to these end states, the frequencies of RC2/RC4 are zero.


NS-R-1 TECHNICAL SAFETY OBJECTIVE
To take all reasonably practicable measures to prevent accidents in nuclear installations and to mitigate their consequences should they occur; to ensure with a high level of confidence that, for all possible accidents taken into account in the design of the installation, including those of very low probability, any radiological consequences would be minor and below prescribed limits; and to ensure that the likelihood of accidents with serious radiological consequences is extremely low.
SAFETY GOALS
Severe Core Damage Frequency
Large Off-site Release Frequency
PLUS
Deterministic Design Rules
ACHIEVED THROUGH MULTIPLE LEVELS OF DEFENCE IN DEPTH
PROPOSED CANADIAN REQUIREMENTS
SAFETY ASSESSMENT
REFERENCE DOSE AND FREQUENCY LIMITS
LEVEL 1 Prevention of abnormal operations and failures
High quality design, materials, construction, proven equipment, qualtity assurance program Control systems to keep within design limits.
Design analysis to show plant controlled within normal operating limits
Allowed doses specified in Radiation Protection Regulations
LEVEL 2 Control of abnormal operation and detection of failures
Control and Protection System
Capable of protecting all AOOs
Protective feature failure rate <10^{-3}/demand
SHUTDOWN CAPABILITY
AOO
DBA
Yes
Limited
Conservative analysis to demonstrate continued operation allowed after AOO
No additional release
Safety Systems
Shutdown System: Failure rate < 10^{-4}/ demand
ECCS: Failure rate < 10^{-3}/demand
Defined mission time
AOO
DBA
Yes
Yes
LEVEL 3 Control of accidents within the design basis
Containment: Failure rate < 10^{-3}/demand
Defined mission time
Low leakage rate
Emergency Heat Removal:
Failure rate < 10^{-3}/demand
Event sequence involving failure of shutdown must have frequency < 10^{-6}/a
Conservative containment analysis to show low leakage
Conservative deterministic analysis to demonstrate all AOOs and DBAs meet tight limits.
AOO
Effective dose < 0.5 mSv
DBA
Effective dose < 5 mSv
Severe Accident
(frequency <10^{-6}/event)
LEVEL 4 Control of severe plant conditions, including prevention of accident progression and mitigation of the consequences of severe accident
Design features of plant to mitigate consequencesof severe accidents.
Severe Accident Management Guidelines
Best estimate analysis to show containment intact for 24 h at design leakage rate.
Controlled releases following 24 h
Severe Core Damage Frequency Total < 10^{-5}/a
Each sequence < 10^{-6}/a
Large Release Frequency
< 10^{-6}/a /reactor
LEVEL 5 Mitigation of radiological consequences of significant releases of radioactive materials
Emergency Response Planning
Evacuation if PAL exceeded
Overall Plant Risk
< Safety Goals