

AD 925-2145

<http://www.gen4.anl.gov>

Roadmap Integration Team Presentation



Evaluation Summaries

**Quarterly Meeting: Washington, D.C.
April 9-11, 2002**

Roadmap Integration Team Presentation

Outline

- 1. Understanding concept evaluations**
- 2. Review evaluation data for concepts**
- 3. Explore a few selected sensitivities**
- 4. Walkdown through the concepts**

Understanding Concept Evaluations

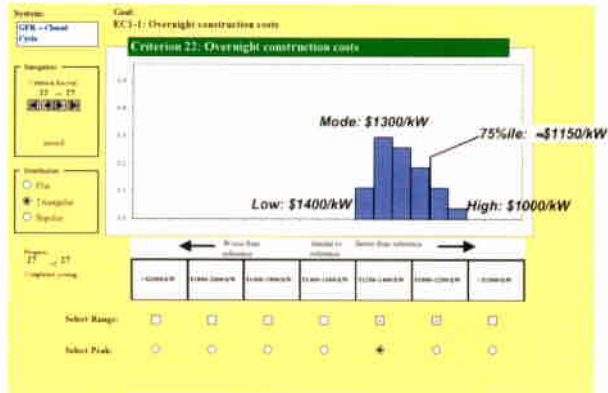
Understanding Concept Evaluations

- 1. Criteria scoring***
- 2. Rolling up criteria into goals***
- 3. Rolling up goals into goal areas***

It is important to remember that selections may consider goal areas, goals, or even individual criteria—all can be useful.

Criteria Scoring Example

- Evaluation Metric for Criteria 22: Overnight Cost
- Low-Mode-High values for distributions
- 75%ile score evaluated numerically by software



Rolling up Criteria into Goals

- **Weighting Factors** (found in Appendix 5 of FSR)
- **Special cases: Calculated criteria/goals**
 - **EC-1 (Average Cost)** is a function of
 - **Criterion 22 (Overnight Cost),**
 - **Criterion 23 (Production Cost), and**
 - **Criterion 24 (Construction Duration)**
 - **EC-2 (Capital at Risk)** is a function of **Criteria 22 & 24**
 - **SU-1 (Fuel Utilization) and SU-2 (Waste Minimization)** are functions of about 5 input values for each concept

Rolling up Goals into Goal Areas

- *All goals weighted equally into the goal area evaluation*
- *SR: 3 goals*
- *SU and EC: 2 goals each*
- *NT: A new goal area with 1 goal (formerly SU-3)*

- *The five page handout summarizes all rollups, from criteria up through goal areas, for all concepts.*

- *Special information, such as the probability distribution for a goal or a goal area, can be found in the concept evaluation spreadsheets (19 files on the participant website).*

Evaluation Data Summaries

The Generation IV Rosetta Stone

Full Name Assigned by TWG	Acronym/ TWG Category	RIT Label	ID
Integral Primary System Reactors	IPSR	IPSR	W1
Simplified Boiling Water Reactors	SBWR	SBWR	W2
CANDU Next Generation	CANDU NG	CANDU NG	W3
Supercritical Water Reactors – Thermal Spectrum	SCWR-T	SCWR-T	W4
Supercritical Water Reactors – Fast Spectrum	SCWR-F	SCWR-F	W5
High Conversion Boiling Water Reactors	HC-BWR	HC-BWR	W6
Pebble Bed Modular Reactors	PBR	PBR	G1
Prismatic Modular Reactors	PMR	PMR	G2
Very High Temperature Reactors	VHTR	VHTR	G3
Generic High Temperature Gas Reactors – Closed Cycle	GCR – closed	HTGR-Closed	G4
Gas Fast Reactor	GFR	GFR	G5
Sodium cooled, MOX fuel, advanced aqueous process	Na/A	Na MOX Aq	L1
Sodium cooled, metal fuel, pyroprocess	Na/B	Na Metal Pyro	L2
Medium Pb/Pb-Bi cooled, Russian design	Pb/C-RF	Pb Large	L4
Medium Pb/Pb-Bi cooled, US design	Pb/C-US	Pb/Bi Small	L3
Small Pb/Pb-Bi cooled	Pb/D	Pb/Bi Battery	L4
Liquid Core Reactors	MSR (Molten Salt Reactor)	MSR	N1
Gas Core Reactors	VCR (Vapor Core Reactor)	VCR	N2
Molten Salt Cooled	AHTR (Advanced High Temperature Reactor)	AHTR	N3

Grouping of Scores by Strength



- **Top Ranking**
 - The top 8 scores, sometimes more or less than 8 due to ties
- **Good**
 - Scores close to the top 8, down to a natural breakpoint, if possible to determine one, or else down to Neutral score
- **Neutral**
 - Scores within ± 0.20 of the ALWR baseline
- **Weak**
 - Scores less than neutral

Goal Area Evaluations and Ranking: Sustainability



System	ID	SU	SR	EC*	NT
Na MOX Aq	L1	0.89	0.44	-0.31	0.23
Na Metal Pyro	L2	0.88	0.47	0.48	0.27
Pb large	L5	0.87	0.42	-0.15	0.27
Pb/Bi small	L4	0.87	0.39	0.27	0.27
Pb/Bi Battery	L6	0.87	0.36	0.42	0.52
GFR	G5	0.85	0.37	0.38	0.26
SCWR-F	W5	0.83	0.19	0.24	0.21
MSR	N1	0.77	0.25	0.10	0.31
VCR	N2	0.72	0.33	-0.10	0.58
HC-BWR	W6	0.71	0.21	-0.56	0.13
HTGR Closed	G4	0.68	0.54	0.56	0.28
SCWR-T	W4	0.16	0.22	0.31	0.09
PBR	G1	0.09	0.60	0.63	0.29
IPSR	W1	0.04	0.43	0.58	0.23
SBWR	W2	0.04	0.36	-0.38	0.12
AHTR	N3	0.04	0.45	0.05	0.29
CANDU NG	W3	0.03	0.35	0.76	0.12
PMR	G2	0.03	0.59	0.56	0.29
VHTR	G3	0.02	0.56	0.56	0.17

Goal Area Evaluations and Ranking: Safety & Reliability



System	ID	SU	SR	EC*	NT
PBR	G1	0.09	0.60	0.63	0.29
PMR	G2	0.03	0.59	0.56	0.29
VHTR	G3	0.02	0.56	0.56	0.17
HTGR Closed	G4	0.68	0.54	0.56	0.28
Na Metal Pyro	L2	0.88	0.47	0.48	0.27
AHTR	N3	0.04	0.45	0.05	0.29
Na MOX Aq	L1	0.89	0.44	-0.31	0.23
IPSR	W1	0.04	0.43	0.58	0.23
Pb large	L5	0.87	0.42	-0.15	0.27
Pb/Bi small	L4	0.87	0.39	0.27	0.27
GFR	G5	0.85	0.37	0.38	0.26
Pb/Bi Battery	L6	0.87	0.36	0.42	0.52
SBWR	W2	0.04	0.36	-0.38	0.12
CANDU NG	W3	0.03	0.35	0.76	0.12
VCR	N2	0.72	0.33	-0.10	0.58
MSR	N1	0.77	0.25	0.10	0.31
SCWR-T	W4	0.16	0.22	0.31	0.09
HC-BWR	W6	0.71	0.21	-0.56	0.13
SCWR-F	W5	0.83	0.19	0.24	0.21

Goal Area Evaluations and Ranking: Economics



System	ID	SU	SR	EC*	NT
CANDU NG	W3	0.03	0.35	0.76	0.12
PBR	G1	0.09	0.60	0.63	0.29
IPSR	W1	0.04	0.43	0.58	0.23
PMR	G2	0.03	0.59	0.56	0.29
VHTR	G3	0.02	0.56	0.56	0.17
HTGR Closed	G4	0.68	0.54	0.56	0.28
Na Metal Pyro	L2	0.88	0.47	0.48	0.27
Pb/Bi Battery	L6	0.87	0.36	0.42	0.52
GFR	G5	0.85	0.37	0.38	0.26
SCWR-T	W4	0.16	0.22	0.31	0.09
Pb/Bi small	L4	0.87	0.39	0.27	0.27
SCWR-F	W5	0.83	0.19	0.24	0.21
MSR	N1	0.77	0.25	0.10	0.31
AHTR	N3	0.04	0.45	0.05	0.29
VCR	N2	0.72	0.33	-0.10	0.58
Pb large	L5	0.87	0.42	-0.15	0.27
Na MOX Aq	L1	0.89	0.44	-0.31	0.23
SBWR	W2	0.04	0.36	-0.38	0.12
HC-BWR	W6	0.71	0.21	-0.56	0.13

Goal Area Evaluations and Ranking: Nuclear Proliferation and Terrorism Resistance



System	ID	SU	SR	EC*	NT
VCR	N2	0.72	0.33	-0.10	0.58
Pb/Bi Battery	L6	0.87	0.36	0.42	0.52
MSR	N1	0.77	0.25	0.10	0.31
PBR	G1	0.09	0.60	0.63	0.29
PMR	G2	0.03	0.59	0.56	0.29
AHTR	N3	0.04	0.45	0.05	0.29
HTGR Closed	G4	0.68	0.54	0.56	0.28
Na Metal Pyro	L2	0.88	0.47	0.48	0.27
Pb large	L5	0.87	0.42	-0.15	0.27
Pb/Bi small	L4	0.87	0.39	0.27	0.27
GFR	G5	0.85	0.37	0.38	0.26
Na MOX Aq	L1	0.89	0.44	-0.31	0.23
IPSR	W1	0.04	0.43	0.58	0.23
SCWR-F	W5	0.83	0.19	0.24	0.21
VHTR	G3	0.02	0.56	0.56	0.17
HC-BWR	W6	0.71	0.21	-0.56	0.13
SBWR	W2	0.04	0.36	-0.38	0.12
CANDU NG	W3	0.03	0.35	0.76	0.12
SCWR-T	W4	0.16	0.22	0.31	0.09

Goal Area Evaluations and Ranking



System	ID	BU	GR	EC*	HT	System	ID	BU	GR	EC*	HT	System	ID	BU	GR	EC*	HT	System	ID	BU	GR	EC*	HT
No MOX As	L1	0.88	0.24	-0.21	0.23	PMR	01	0.99	0.88	0.84	0.29	CANDU NG	W2	0.31	0.35	0.76	0.17	SWR	W2	0.72	0.33	-0.10	0.24
No Mixed Pyro	L2	0.86	0.25	-0.16	0.27	PMR	02	0.99	0.89	0.86	0.29	PMR	01	0.98	0.80	0.82	0.28	Public Battery	L2	0.87	0.26	-0.16	0.23
PM large	L5	0.87	0.42	-0.15	0.27	WTR	03	0.82	0.86	0.88	0.17	PMR	W1	0.04	0.43	0.68	0.25	PMR	H1	0.77	0.20	-0.10	0.21
Public Battery	L4	0.87	0.26	-0.27	0.27	WTR Closed	04	0.88	0.84	0.86	0.28	PMR	G2	0.01	0.56	0.86	0.26	PMR	G1	0.06	0.80	0.80	0.26
QPR	02	0.86	0.27	-0.26	0.28	No Mixed Pyro	L2	0.88	0.87	0.88	0.27	WTR	G2	0.01	0.56	0.86	0.27	PMR	G2	0.01	0.80	0.86	0.26
SCWR of	H1	0.82	0.16	-0.28	0.21	WTR	H2	0.84	0.86	0.86	0.28	WTR Closed	04	0.88	0.84	0.86	0.28	WTR	H2	0.84	0.86	0.86	0.28
WTR	H1	0.77	0.20	-0.10	0.21	No MOX As	L1	0.88	0.88	-0.21	0.23	No Mixed Pyro	L2	0.88	0.87	0.88	0.27	WTR Closed	04	0.88	0.84	0.86	0.28
WTR	H2	0.72	0.23	-0.10	0.24	PMR	W1	0.04	0.43	0.68	0.25	Public Battery	L2	0.87	0.26	-0.16	0.23	No Mixed Pyro	L2	0.88	0.87	0.88	0.27
HC-BWR	W8	0.71	0.25	-0.16	0.13	Public Battery	L2	0.87	0.26	-0.16	0.23	SCWR T	W4	0.70	0.22	0.24	0.05	Public Battery	L2	0.87	0.26	-0.16	0.23
WTR Closed	04	0.88	0.84	0.86	0.28	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
SCWR T	W4	0.70	0.22	0.24	0.05	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
PMR	G1	0.06	0.80	0.80	0.26	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
PMR	W1	0.04	0.43	0.68	0.25	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
PMR	W2	0.04	0.38	-0.38	0.12	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
WTR	H1	0.84	0.86	0.86	0.28	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
CANDU NG	W3	0.29	0.38	0.76	0.17	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
PMR	G2	0.01	0.80	0.86	0.26	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
WTR	H2	0.84	0.86	0.86	0.28	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
WTR	H1	0.77	0.20	-0.10	0.21	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
PMR	G2	0.01	0.80	0.86	0.26	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23
WTR	H2	0.84	0.86	0.86	0.28	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23	Public Battery	L2	0.87	0.26	-0.16	0.23

Examination of Selected Sensitivities

Economics Goal Evaluations and Ranking: Sensitivity to Goal Weights

50/50 EC					67/33 EC						
System	ID	SU	BR	NT	System	ID	SU	BR	NT		
CARDU NG	W3	0.03	0.31	0.75	0.12	CARDU NG	W3	0.03	0.35	0.79	0.12
PBR	G1	0.09	0.60	0.43	0.29	PBR	G1	0.09	0.60	0.32	0.29
IPSR	W1	0.04	0.43	0.58	0.23	IPSR	W1	0.04	0.43	0.45	0.23
PWR	G2	0.05	0.39	0.66	0.28	SCWR-T	W4	0.16	0.22	0.54	0.39
VHTR	G3	0.03	0.66	0.46	0.17	PWR	G2	0.03	0.69	0.43	0.29
HTOR Closed	G4	0.68	0.54	0.55	0.28	VHTR	G3	0.02	0.66	0.43	0.17
Na Metal Pyro	L2	0.88	0.47	0.48	0.27	HTOR Closed	G4	0.68	0.54	0.43	0.28
Pb/Bi Battery	L6	0.87	0.38	0.42	0.21	SCWR-F	W5	0.83	0.19	0.35	0.21
GFR	G5	0.85	0.07	0.38	0.26	Na Metal Pyro	L2	0.88	0.47	0.34	0.27
SCWR-T	W4	0.16	0.22	0.31	0.59	Pb/Bi Battery	L6	0.87	0.38	0.24	0.26
Pb/Bi small	L4	0.87	0.39	0.27	0.27	GFR	G5	0.85	0.07	0.29	0.26
SCWR-F	W5	0.83	0.19	0.24	0.21	Pb/Bi small	L4	0.87	0.39	0.24	0.27
MSR	N1	0.77	0.25	0.10	0.31	MSR	N1	0.77	0.25	0.02	0.31
AHTR	N3	0.04	0.45	0.95	0.28	AHTR	N3	0.04	0.45	-0.05	0.28
VCR	N2	0.72	0.33	-0.10	0.58	Pb large	L5	0.87	0.42	-0.12	0.27
Pb large	L5	0.87	0.42	-0.15	0.27	VCR	N2	0.72	0.33	-0.15	0.58
Na MOX Aq	L1	0.88	0.44	-0.21	0.23	Na MOX Aq	L1	0.88	0.44	-0.34	0.23
SBWR	W2	0.94	0.36	-0.38	0.12	SBWR	W2	0.94	0.36	-0.41	0.12
HC-BWR	W6	0.71	0.21	-0.58	0.13	HC-BWR	W6	0.71	0.21	-0.54	0.13

* See next slide for explanation of 50/50 and 67/33 weighting of EC-1 and EC-2

Results of Sensitivity Studies

- 'Investment weighting' of EC-1 (67%) and EC-2 (33%):
 - Large SCWRs (W4, W5) rise from Good to Best
 - Small Na metal Pyro (L2) and Pb/Bi Battery (L6) fall from Best to Good
 - Separation of NT out of SU:
 - Na MOX Aq (L1) and Pb/Bi Battery (L6) swap, but stay in Best
 - MSR (N1) rises from Good to Best
 - VCR (N2) falls from Best to Good
- ...these were caused by very small changes in scores

Walkdown of Concepts

Walkdown: General Ordering by Strength

Best In	System	ID	Strengths	Composite	
				Score	Rank
3	Na Metal Pyro	L2	SU, SR, EC, Good NT		1
3	HTDR closed	G4	SR, EC, NT, Good SU		2
3	Pb/Bi battery	L8	NT, SU, EC, Good SR		3
3	PBR	G1	SR, EC, NT, Neutral SU		6
3	PMR	G2	SR, EC, NT, Neutral SU		7
2	MSR	N1	SU, NT, Good SR, Neutral EC		11
2	IPSR	W1	EC, SR, Good NT, Neutral SU		13
2	Na MOX Aq	L1	SU, SR, Good NT, Weak EC		15
2	VHTR	G3	SR, EC, Neutral NT, Neutral SU		8
2	AHTR	N3	SR, NT, Neutral EC, Neutral SU		16
1	GFR	G5	SU, Good EC, Good SR, Good NT		4
1	Pb/Bi small	L4	SU, Good SR, Good NT, Good EC		5
1	Pb large	L5	SU, Good SR, Good NT, Neutral EC		9
1	SCWR-F	W5	SU, Good EC, Good NT, Neutral SR		10
1	VCR	N2	NT, Good SU, Good SR, Neutral EC		12
1	CANDU NG	W3	EC, Good SR, Neutral SU, Neutral NT		14
0	SCWR-T	W4	Good EC, Good SR, Neutral SU, Neutral NT		17
0	HC-SWR	W6	Good SU, Good SR, Neutral NT, Weak EC		18
0	SBWR	W2	Good SR, Neutral SU, Neutral NT, Weak EC		19

Additional Considerations: Missions

- 'Missions' was an idea discussed at the GIF London meeting
- Its purpose is to assure that the 6-8 concepts will adequately address a variety of important future needs, especially those for alternative energy products and fuel cycles
- Four major missions currently identify:
 - Large Grid Electricity Producer (E1)
 - Small Grid Electricity Producer (E2)
 - Hydrogen/High Temperature (H)
 - Actinide Management (AM)
 - Waste burndown
 - Fissile creation

Additional Considerations: Missions

Missions	Concepts			
	Water	Gas	Liquid Metal	Non-classical
E1 Electricity Generation (Large Grid Plant) 8 concepts	CANDU-N0 (W3) SBWR (W2) HC-BWR (W6) SCWR-T (W4) SCWR-F (W5)		Na/A (L1) Pb/C-RF (L5)	MSR (N1)
E2 Electricity Generation (Small Grid Plant) 11 concepts	IFBR (W1)	PBR (G1) PMR (G2) GCR-closed (G4) VHTR (G3) GFR (G5)	Na/B (L2) Pb/C-US (L4) Pb/D (L8)	AHTR (N3) VCR (N2)
H High Temperature Heat Applications (Hydrogen, etc.) 9 concepts		PBR (G1) PMR (G2) GCR-closed (G4) VHTR (G3) GFR (G5)	Pb/D (L8)	AHTR (N3) MSR (N1) VCR (N2)
AM Waste Consumption 8 concepts	SCWR-F (W5)	GFR (G5)	Na/A (L1) Na/B (L2) Pb/C-US (L4) Pb/D (L8)	MSR (N1) VCR (N2)
Fissile Creation 7 concepts	HC-BWR (W6) SCWR-F (W5)	GCR-closed (G4) GFR (G5)	Na/A (L1) Na/B (L2)	MSR (N1)

Additional Considerations: Development Cost

Development Costs* (\$Billions)

Concept	ID	Percentile		
		75%	50%	25%
SBWR	W2	0.172	0.190	0.208
CANDU NG	W3	0.299	0.320	0.365
IPSR	W1	0.400	0.450	0.500
PBR	G1	0.499	0.520	0.618
Na MOX Aq	L1	0.500	0.550	0.775
PMR	G2	0.663	0.775	0.888
HC-BWR	W6	0.663	0.775	0.888
HTGR Closed	G4	0.663	0.775	0.888
SCWR-T	W4	0.770	0.904	1.150
AHTR	N3	0.775	1.000	1.500
VHTR	G3	0.933	1.214	1.510
Pb/Bi Battery	L6	0.933	1.214	1.510
SCWR-F	W5	0.933	1.214	1.510
Na Metal Pyro	L2	0.933	1.214	1.510
MSR	N1	1.054	1.500	1.946
Pb Large	L5	1.054	1.500	1.946
Pb/Bi Small	L4	1.054	1.500	1.946
GFR	G5	1.250	1.500	1.750
VCR	N2	1.850	2.257	2.613

* Includes R&D and demonstration costs; does not include first-of-a-kind engineering or licensing costs

Walkdown: Additional Considerations

Rank	System	ID	Strengths	Composite		Development	
				Score	Rank	Timeline	Deploy
3	Na Metal Pyro	L2	SU, SR, EC, Good NT	1	AM, E2	mid	1.2
3	HTGR closed	G4	SR, EC, NT, Good SU	2	AM, E2	mid	0.8
3	Pb/Bi battery	L6	NT, SU, EC, Good SR	3	E3, H, AM	long	1.2
3	PBR	G1	SR, EC, NT, Neutral SU	6	E2	near	0.5
3	PMR	G2	SR, EC, NT, Neutral SU	7	E2	near	0.8
2	MSR	N1	SU, NT, Good SR, Neutral EC	11	E1, AM	long	1.5
2	IPSR	W1	EC, SR, Good NT, Neutral SU	13	E2	near	0.5
2	Na MOX Aq	L1	SU, SR, Good NT, Weak EC	15	AM, E1	mid	0.8
2	VHTR	G3	SR, EC, Neutral NT, Neutral SU	8	H	mid	1.2
2	AHTR	N3	SR, NT, Neutral EC, Neutral SU	16	H	long	1.0
1	GFR	G5	SU, Good EC, Good SR, Good NT	4	AM, E2	long	1.5
1	Pb/Bi small	L4	SU, Good SR, Good NT, Good EC	5	AM, E2	long	1.5
1	Pb large	L5	SU, Good SR, Good NT, Neutral EC	9	E1, AM	long	1.5
1	SCWR-F	W5	SU, Good EC, Good NT, Neutral SR	10	E1, AM	long	1.2
1	VCR	N2	NT, Good SU, Good SR, Neutral EC	12	E1, AM, H	long	2.3
1	CANDU NG	W3	EC, Good SR, Neutral SU, Neutral NT	14	E1	near	0.3
0	SCWR-T	W4	Good EC, Good SR, Neutral SU, Neutral NT	17	E1	mid	0.9
0	HC-BWR	W6	Good SU, Good SR, Neutral NT, Weak EC	18	AM, E1	mid	0.8
0	SBWR	W2	Good SR, Neutral SU, Neutral NT, Weak EC	19	E1	near	0.2

Key: E1: Large grid electricity
 E2: Small grid electricity
 H: Hydrogen/High Temperature
 AM: Actinide management

near: before 2015
 mid: 2015-2020
 long: 2020-2030

Walkdown: Early Efforts at Draft Selections

<i>TWGCC Report*</i>	<i>RIT Analysis**</i>	<i>After GRNS Discussions***</i>
CANDU	--	(identify as a transition technology)
PMR	--	(identify as a transition technology)
SCWR-T	SCWR-F	✓ SCWR-T (F is long-term option)
VHTR	VHTR	✓ VHTR
GFR	GFR	✓ GFR
Pb/Bi Small	Pb/Bi Small	✓ Pb/Bi Small (battery is long-term option)
Pb/Bi 'Battery'	Pb/Bi 'Battery'	
Na Metal Pyro	Na Metal Pyro	✓ Na systems with R&D focused on fuel cycle closure (Pyro & Aq options)
Na MOX Aq	--	(examine R&D)
VCR	--	(examine R&D)
--	AHTR	(Th cycle not a priority)
--	HTGR-Closed	

* Prepared during Houston meeting Mar 5-8

** Prepared after evaluations finalized, in preparation for GRNS meeting

*** Discussed at GRNS meeting Apr 2-3

These drafts have not been reviewed or endorsed by GIF.