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Attention: Robert C. Pierson, Director
Standardization and Non-Power Reactor Project Directorate

Subject: **Comparison of U.S. ABWR and K-6/7**

Enclosed are thirty-four (34) copies of the differences between the U.S. ABWR and the K-6/7 project. The ABWR design is still being reviewed for differences to the K-6/7 design and any additional differences will be included in the listing that will be incorporated in a future amendment to the ABWR SSAR.

Sincerely,

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COMPARISON OF U.S. ABWR AND K-6/7

DIFFERENCES

U.S. ABWR	K-6/7 COMMENTS	REQUIREMENT/
1. **General Design**		
1.1 Single unit plant	Dual unit between dual units and other site units	Some facilities shared
1.2 Seismic 0.3g SSE all soils envelope	Seismic site specific	ALWR
1.3 60 year plant life	40 year	ALWR
1.4 Ultimate heat sink maximum temperature of 95°F assumed	Maximum temperature of 85°F assumed	U.S. design supports generic site envelope
1.5 U.S. Codes and Stds	MITI Codes and Stds	NRC
1.6 ABWR Product Structure	K-6/7 Product structure	
1.7 Grid frequency 60 Hz	50 Hz	
1.8 Radwaste system design customized for U.S.	Standard Hitachi/Toshiba design	
2. **Plot Plan**		
2.1 Turbine building & tubrine axis in-line with reactor building	Axis perpendicular to reactor building perspective to have a more compact site plot plan	ALWR/Japanese choose to address turbine missile issue entirely from a structural
2.2 Steam line volume less than 1000 cu. ft.		
2.3 Control building located between reactor building and turbine building	Located between dual reactor buildings	
a. Control room HVAC includes dual widely separated operator selectable air intakes	Single air intake	Dual intake design results in less dose to operator in U.S. control room exposure analysis

DIFFERENCES (Continued)

b. RCW HX's located in basement of control building	Dedicated HX building	U.S. layout reconfigured to reflect different site plot plan
c. RIP MG sets located in control building		
2.4 Radwaste building designed for a single unit	Shared facilities on multi-unit site. K-6/7 (ABWR) share facilities with K-5 (BWR-5)	Japanese emphasis on efficiency and compact site layout
2.5 Technical support center located in service building		NRC
2.6 Condensate storage tank in yard	Storage pool located in in radwaste building	
2.7 Dual unit common switch-gear deleated	Common switchgear used	
3. **Power Cycle System**		
3.1 Power cycle system design meets U.S. utility preference, with emphasis on simplicity.	Japanese emphasis is on maximum heat rate and thermal efficiency	ALWR
a. FW pumps driven by variable speed motor	Steam driven pumps	
b. Condensate has 4x33$^1/_3$% pumps; no condensate booster pumps	Condensate pumps plus booster pumps; 3x50% pumps at each stage	
c. Low pressure FW heater drains cascaded back to condenser	Pumped forward	High pressure heater drains pumped forward in both designs
d. Moisture separator/re-heaters have 1 stage reheat	2 stage reheat	
e. Condenser is multiple pressure	Single pressure	
f. Condenser tubing cooling water dependent	Titanium	ALWR requirements allow use of materials suitable for actual site cooling water conditions

DIFFERENCES (Continued)

g. Turbine gland sealing steam extracted from main steam	Dedicated system supplies clean steam	
h. Steam jet air ejectors has 2x100% trains	1 100% train plus 1 startup train (driven by auxiliary steam)	
i. Condenser heat sink site dependent	Seawater	
j. TBCW system has 2x 100% pumps and Hxs	3x50% pumps and Hxs	
k. Condensate polishing is two stage	Single stage	Meets water quality exposure & radwaste burial volume goals
3.2 Offgas system is GE N68 design	H/T design based on earlier GE N62 design	
3.3 Hydrogen water chemistry integral with design	Not adopted	Desirability still under study in Japan
3.4 Provision for Zinc addition to Feedwater	No Zinc addition	Zinc addition is optional
4. **Electrical Design**		
4.1 Offsite/onsite AC power sources are the low voltage generator output breaker plus one independnent offsite source plus non-safety onsite gas turbine	7 unit site with multiple offsite AC power sources	U.S. design reflects ALWR requirements (both designs include normal compliment of emergency diesel generators)
4.2 Onsite power distribution network has generator output breaker and feed from gas turbine added; startup transformers deleted	No generator output breaker or gas turbine; startup transformers used to provide feed in conventional way	AC network interface designed for repsective site conditions (switching logic also modified accordingly)
4.3 Isolation of 1E from non-1E loads on low voltage ac/dc circuits		

4.4 DG fuel storage is 3x100% divisionally separated tanks located underground	2x200% divisionally cross-tied tanks (per reactor unit) located above ground	K-6/7 design emphasizes compact site plot plan; cross ties allowed by less rigorous divisional separation requirements
4.5 DG start capability incorporates manual (no AC) start capability	Normal capability	ALWR
4.6 DG fire suppression is foam system	CO_2 system	ALWR
4.7 No PVC electrical insulation allowed	Use of PVC OK	ALWR
4.8 Non-safety chillers and coolers connectable to on-site gas turbine	Gas turbine is not required	ALWR
5. **Primary Containment**		
5.1 Severe accident design features	Not part of design	Subject of severe accident mitigation is still under study in Japan
a. Containment overpressure protection		Passive venting of wetwell airspace through two rupture discs in series in hardened path; containment integrity recoverable by closing normally open AOVs
b. Strengthened drywell head		Drywell head thickness increased from 1" to 1.25"; Pressure capability increased to near ultimate strength of balance of the containment structure
c. Limestone concrete prohibited in lower drywell area		Reduces non-condensible gas generation from potential core-concrete interaction
d. Lower drywell flooder		Utilizes fusible plugs on pipes connecting suppression pool to lower drywell
e. AC independent water addition capability		Fire water system cross-tied into RHR with manually operated valves

COMPARISON OF U.S. ABWR AND K-6/7

DIFFERENCES (Continued)

f. Onsite combustion turbine generator		ALWR
5.2 Wetwell/Drywell vacuum breakers with test circuit auto return to normal logic on LOCA signal	No auto return logic, LOCA during test mode considered to have sufficiently small probability of occurrence as to be negligible	Vacuum breakers are air testable check valves; auto return logic exhausts air from test actuator on LOCA signal to return valve to normal swing check mode
5.3 SRV discharge piping in wetwell region specified as ASME Class 2 (MITI Class 3 equivalent) therefore, ISI is required	Specified as MITI Class 4 so no ISI required	NRC
5.4 RPV metal temperature sensor reduction	K-6/7 to have extra monitoring capability	ALWR/Extra monitoring capability not needed for follow-on plants
6 **Secondary Containment**		
6.1 Redundant flammability control system (hydrogen recombiners) permanently installed	Portable skids - one skid normally installed in reactor building of each unit	For K-6/7 redundancy is provided by portability of skid in other unit's reactor building
6.2 SGTS has 4000 scfm capacity with auto negative pressure control capability	1200 scfm capacity	Less prescriptive requirements for SGTS sizing in Japan; Increased capacity of U.S. system necessitates capability to control negative pressure to prevent excessive differential pressure on reactor building
6.3 Steam and FW lines classified non-seismic outboard of seismic interface restraint	Seismic out to turbine; no seismic interface restraint	Seismically qualified turbine building is standard Japanese practice
a. Leak-before-break methodology used to eliminate pipe whip restraints	Conventionally analyzed and supported	Leak-before-break methodology still under study in Japan
6.4 HPCF pumps discharge check valve		NRC/High pressure isolation

COMPARISON OF U.S. ABWR AND K-6/7

DIFFERENCES (Continued)

6.5 ECCS injection valve handwheel and improved position monitoring		Subsection 19C.4(1) & (3)
6.6 CRD pump motor overspeed 25%	20%	U.S. Codes and Standards
6.7 Reactor building secondary containment air lock		Truck shipping access
7. Control Room		
7.1 ARBM logic enforces OLMCPR, even in Manual mode, to prevent Rod Withdrawal Error transient	Logic does not enforce OLMCPR in manual mode; RWE transient analyzed as acceptable	ARBM enforcement of OLMCPR in all modes eliminates RWE as credible transient in U.S.; thus, analysis is not required
7.2 Automatic boron injection	Manual	NRC/Recirculation run back and ARI/FMCRD run in initiated from scram
7.3 Automatic suppression pool cooling for 72 hours	Manual	
7.4 Automatic ADS after additional 8 minutes without high drywell pressure	Manual	NRC
a. ADS includes manual inhibit switch on main control panel	Inhibit switch not provided	ADS inhibit switch required in U.S. to help mitigate ATWS
b. Monitor solenoid continuity for ADS SRVs		Subsection 19C.4(4)
7.5 RPS seismic trip is not an RPS input	Trip on high ground acceleration	Seismic scram trip is standard Japan practice
a. TCV solenoid position trip is not an RPS input	Trip on TCV solenoid position switch input	Standard Japan practice
7.6 RPV water level instrumentation reference zero at TAF for all instruments	Reference zero at TAF for fuel zone range only; all others use bottom of separator skirt for reference zero	In Japan, it was decided that least confusing solution is to retain past BWR practice (U.S. designed dictated by TMI Action Plan item)

COMPARISON OF U.S. ABWR AND K-6/7

DIFFERENCES (Continued)

7.7 Safety related RHR Hxs outlet temperature monitor	Non 1E	NRC
7.8 Keylock switch on RHR discharge valve to radwaste	No keylock	ALWR
8. **Water/Air**		
8.1 RCW has 3x50% vertical HXs (per division)	2x100% horizontal HXs (per division)	Differing configurations reflective of locational space constraints
a. Corrosion monitoring subsystem included	Not included	ALWR
8.2 Essential HVAC has cooling coils in all 3 divisions; division C serves control room	Division C uses forced air only for reactor building loads and does not serve control room	Division C has less heat load and cooling coils not needed at actual conditions of K-site; U.S. design must support generic site envelope
a. HVAC essential cooling water divisions A, B & C	Divisions A & B only	
b. Drain collection to radwaste or recycle to RCW	Storm drains	ALWR
8.3 HVAC normal cooling water system has increased size	Smaller size	U.S. system has larger capacity to accommodate generic site envelope
8.4 RCIC room dedicated sump	Shared sump with RHR 'A'	Dedicated RCIC sump provides considerable PRA benefit from flooding evaluation
8.5 Instrument air system has manual cross-tie back-up to nitrogen supply	Auto-transfer to back up nitrogen supply mode	There is a cross-tie between K-5, K-6 and K-7
8.6 Breathing air is dedicated system	Supplied by service air	
8.7 Service air filters and dryers added	No filters and dryers	ALWR

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DIFFERENCES (Continued)

9. **Fire Protection**		
9.1 Physical fire barriers with 3 hour ratings used at all divisional boundaries outside containment high energy piping penetrations also require 3 hour fire ratings (or appropriate justifiucation otherwise)	Some interdivisional equipment located in common areas designated as "non-fire zone". Penetrations do not require 3 hour ratings	Japanese practice allows some areas that contain safety related equipment(including of different divisions) to be subject to less strict fire protection requirements if supported by analysis showing probability or size of fire to be low
9.2 U.S. design has dedicated smoke removal mode consisting of dampers and logic	No such mode is required	U.S. requires capability to exhaust smoke and prevent migration to other divisions
9.3 Four SRVs controllable at Remote Shutdown Panel (RSP)	3 SRVs controllable per original design; U.S. design change still under study	Addition of 4th SRV at RSP improves results of fire PRA by factor of 10
10. **Radiation**		
10.1 Containment leakage 0.5%/day assumed in dose analysis	0.4%/day assumed	Japanese data shows consistently less leakage than in U.S.; U.S. assumption reflects utility desire to retain margin for test
10.2 MSIV leakage 140 scfh total for all lines assumed in dose analysis	45 scfh total assumed	Historic Japanese data shows consistently less leqakage than in U.S.; U.S. assumption reflects utility desire to retain margin for test
10.3 Reconfigure ARM & PRM systems to U.S. design	Site specific	Accomodate plant arrangement and processes