KHNP Uses EPRI's Full System Equivalency Methodology to Streamline Steam Generator Eddy Current Inspections

2025 TECHNOLOGY TRANSFER AWARD

Traditionally, steam generator (SG) eddy current testing (ECT) site validation requires checking roughly 23 essential parameters one at a time—a slow and complicated process. By adopting EPRI's Steam Generator Management Program (SGMP) Full System Equivalency (FSE) approach, Korea Hydro & Nuclear Power Co., Ltd. (KHNP) has been able to streamline its validation process across nuclear plant sites, reducing time and cost while achieving a more practical and meaningful demonstration of equivalency.

Benefits

Using EPRI's FSE methodology to improve SG eddy current inspection efficiency delivered major gains for KHNP. The utility saved about $124,000 USD annually in labor costs by cutting 20 man-days per unit from inspection time and shortening overall inspections by 1.5 man-days. Simplified field validation also reduced preparation time and radiation exposure, generating an additional estimated savings of $305,000 USD per year.

Beyond cost reductions, KHNP achieved more reliable inspections—reflected in 100% positive vendor feedback—and improved regulatory alignment through use of internationally recognized standards. Standardizing the FSE approach across the entire KHNP fleet supports long-term consistency, operational efficiency, and technical stability.

Application

KHNP led the first Korean deployment of EPRI's SGMP FSE methodology, reviewing SG Examination Technique Specification Sheet (ETSS) data, piloting the approach at its plants, updating internal SG ECT guidelines, and training in-service inspection vendors. EPRI supported the effort by providing the methodology, technical data, and ongoing feedback, helping KHNP transition from parameter-specific checks to a system-wide validation process.

Collaboration across KHNP's research institute, plant sites, headquarters, and six domestic vendors enabled company-wide adoption. This project marks the first time a utility has developed equivalent examinations for all its plants and vendors, helping ensure every inspection team follows a qualified, standardized approach.

Key EPRI resources driving this project included:

- PWR Steam Generator Examination Guidelines, 3002007572, and the SGMP Examination Technique Specification Sheets (ETSSs)
- Development of Documentation for Examination Technique Equivalencies, 1020992
- Development of Standardized Process for Determining Examination Technique Equivalency, 1018557
- Eddy Current System Examination Technique Equivalency Process, 3002005383
- Eddy Current Array Probe Documentation for Examination Technique Equivalency, 3002010707

Figure 1
Shows training for domestic in-service inspection vendors.

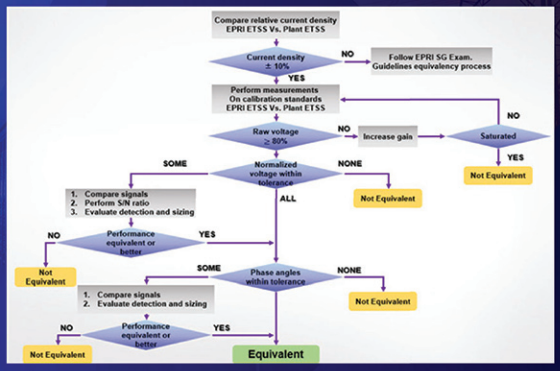
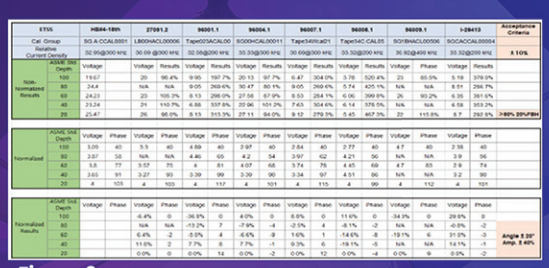


Figure 2
Compares EPRI's ETSS with the plant's ETSS through an equivalency flowchart.



ETSS		HB84-18th		27091.2		96001.1		96004.1		96007.1		96008.1		96009.1		I-28413		Acceptance Criteria
Cal. Group		SG A CCALB001		LB09HACL00006		Tape023ACL00		S009HCAL00011		Tape34HcalC1		Tape34C-CAL05		SG1B4hCL00006		SG3ACCALB0084		
Relative Current Density		30.9@300 kHz		26.99 @300 kHz		30.06@200 kHz		30.03@300 kHz		30.08@300 kHz		33.30@200 kHz		30.80@400 kHz		33.30@200 kHz		± 10%
ASME Std. Depth		Voltage				Voltage	Results	Voltage	Results	Voltage	Results	Voltage	Results	Voltage	Phase	Voltage	Results	
Non-Normalized Results	100	19.67			20	98.4%	9.95	197.7%	20.13	97.7%	6.47	304.0%	3.78	520.4%	23	85.5%	5.19	379.0%
	80	24.4			N/A	N/A	9.05	269.6%	30.47	80.1%	9.05	269.6%	5.74	425.1%	N/A	N/A	8.51	286.7%
	60	24.23			23	105.3%	8.13	298.0%	27.58	87.9%	8.53	284.1%	6.06	399.9%	26	90.2%	6.35	381.6%
	40	23.24			21	110.7%	6.88	337.8%	22.94	101.2%	7.63	304.6%	6.14	379.5%	N/A	N/A	4.58	353.2%
	20	25.47			26	98.0%	8.13	313.5%	27.11	94.0%	9.12	279.3%	5.45	467.5%	22	115.8%	8.7	292.6%
																		>80% 20%FSH
ASME Std. Depth		Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	
Normalized	100	3.09	40	3.3	40	4.69	40	2.97	40	2.84	40	2.77	40	4.7	40	2.38	40	
	80	3.87	50	N/A	N/A	4.46	65	4.2	54	3.97	62	4.21	56	N/A	N/A	3.9	56	
	60	3.8	77	3.57	75	4	81	4.07	68	3.74	78	4.45	69	4.7	83	2.9	74	
	40	2.65	91	3.27	90	3.39	99	3.39	90	3.34	97	4.51	86	N/A	N/A	3.2	90	
	20	4	105	4	103	4	117	4	101	4	115	4	99	4	112	4	101	
ASME Std. Depth		Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	Voltage	Phase	
Normalized Results	100			-6.4%	0	-36.9%	0	4.0%	0	8.6%	0	11.6%	0	-34.3%	0	29.8%	0	
	80			N/A	N/A	-13.2%	7	-7.9%	-4	-2.5%	4	-8.1%	-2	N/A	N/A	-0.8%	-2	
	60			6.4%	-2	5.0%	4	-6.6%	-9	1.6%	1	14.6%	-8	-19.1%	6	31.0%	-3	Angle ± 20° Amp. ± 40%
	40			11.6%	2	7.7%	8	7.7%	-1	9.3%	6	-19.1%	-5	N/A	N/A	14.1%	-1	
	20			0.0%	0	0.0%	14	0.0%	-2	0.0%	12	0.0%	-4	0.0%	9	0.0%	-2	

Figure 3
Displays the full system site-validation worksheet.

EPRI