

Plant	Client	Contract Code	Document ID				Contract No.			
MRPL Mangalore	MRPL	WSS for PFCC Flue Gas	6723-IEX-G00-EC-0001-A101				66-6723			
	Indicative Inspection and Test plan for Static Equipment - Pressure Vessels, Heat Exchangers, Columns, Reactors, Separators, Tanks, Stack, Cyclones									
										Rev

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		Classification Group 1				Classification Group 2				Classification Group 3				Classification Group 4			
		Mfr.	LSTK Contractor	TPIA	PMC/Owner	Mfr.	LSTK Contractor	TPIA	PMC/Owner	Mfr.	LSTK Contractor	TPIA	PMC/Owner	Mfr.	LSTK Contractor	TPIA	PMC/Owner

1	QAP	Δ	■	■	■	Δ	■	■	■	Δ	■	■	■	Δ	■	■	■	X
	Procedures	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		Δ	☀	☀		
	Welding																	
2	Welding Procedure Qualification (WPS) / Procedure Qualification Records (PQR)/WPQ acc. to ASME Code Section IX, and order specifications.	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		Δ	☀	☀		X
3	Weld Plan with supporting WPS/PQR as per specifications.	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		X
4	PTC Plan, where applicable in code and specifications.	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		X
5	Verification of Test certificate of welding consumables, electrodes as per code, specifications	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		X
	Non-destructive Test (NDT)																	
6	NDT procedures as per code and specifications	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		X
7	NDT Plan	Δ	☀	☀	X	Δ	☀	☀	X	--	☀	--	X	--	☀	--		X
	Post weld heat Treatment																	
8	Post weld Heat treatment Plan & procedures with sketch	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		X
	Testing and Manufacturing Procedures																	
9	Hydro test, Surface Preparation & Painting, Pickling & passivation & any other such procedures.	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀	X	Δ	☀	☀		X
10	Pre-inspection meeting	■	Δ	■	X	■	Δ	■	X	■	Δ	■	X	■	Δ	■		X
	Material Identification																	
11	Identification & Stamp transfer based on review of Material Test Certificates for all pressure bearing parts and parts directly welded to pressure bearing parts. Verification of all requirements as per the Order specifications. Wherever tPI inspection at mill is specified, the same shall be met.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■		
12	Identification & Stamp transfer (TKIS-India or Vendor) based on review of Material Test Certificates for all Process fluid contact parts, Verification of all requirements as per the Order specifications.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■		
13	Identification & stamp transfer based on review of Material Test Certificates for all non- pressure parts. Verification of all requirements as per the Order specifications.	Δ	□	X		Δ	□	X		Δ	□	X		Δ	□	X		

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14	UT : Plates, forgings or other product form - as specified in Drawings / Design Data Sheets, as per specifications.	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
15	UT : Clad Plates - as specified in Drawings / Design Data Sheets, as per specifications.	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
16	MT/PT : Surface of forgings, after machining- as specified in Drawings / Design Data Sheets, as per specifications.	Δ	□	□		Δ	□	□		Δ	□	X		Δ	X	X	
17	PMI of materials, welds for all LAS, SS, Nonferrous materials as applicable in specs	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
18	Inspection of Base ring Template & issue of separate release order for the same.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
19	Set-ups for LS. MT/PT/UT of LS, as applicable. PTC, along with PT of weld edges, as applicable.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
20	Set-ups for CS along with PT of weld edges. MT/PT/UT of CS, as applicable. PTC, as applicable	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
21	Set-ups of seams of nozzles along with PT of weld edges – pipe / flange / fittings: MT/PT/UT as applicable	Δ	□	□		Δ	□	□		Δ	X	X		Δ	X	X	
22	Set-ups for NCS. MT/PT/UT of NCS, as applicable. PTC, as applicable	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
23	MT/PT: back-chip prior to welding the reverse side and root pass weld for single side weld	Δ	□	X		Δ	□	□		Δ	□	□		Δ	□	□	
24	UT at the area of lifting lugs, trailing lugs, trunions as specified	Δ	□	X		Δ	□	X		Δ	X	X		Δ	X	X	
25	RT of LS Prior to forming of dished ends, Shells, cones and knuckles (X for films review)	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
26	Formed parts: Profile, Dimensions, thickness, RT, PT of Knuckle (inside & outside)/ SF / Weld edges,	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
27	Heat treatment of Formed parts, as applicable.	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
28	Testing of representative test coupon for formed part, as applicable in specification.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
Non-destructive tests prior to PWHT, as applicable																	
29	RT/UT/TOFD/PAUT/PT/MT/PMI, Hardness as applicable (X for films review)	Δ	X/□	X/□													
30	Clearance for final PWHT -The checks given in points 39 to 46 & 54.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
Post weld Heat treatment, as applicable																	
31	Review of heat treatment records.	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
32	PTC testing, as applicable in specification	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	

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	Non-destructive tests prior to pressure test (after final heat treatment)																
33	RT / UT / PAUT / TOFD as applicable.	Δ	■	□/X		Δ	□/X	□/X		Δ	□/X	□/X		Δ	X	□/X	
34	PT : 100% weld ring gasket, top layer of fillet seam MPT/ PT : 100% first & top of closing seams and top layer of lifting lugs, trunions	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
35	Hardness test on welds, HAZ, PM & Ferrite tests as applicable	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
	Non-destructive tests after pressure test									Only of specified in design code or other referenced standards/specifications				Only of specified in design code or other referenced standards/specifications			
36	UT / PAUT / TOFD as applicable in specification.	Δ	□/X	□/X		Δ	□/X	□/X		Δ	□/X	□/X		Δ	X	□/X	
37	MPT/PT : 100% T - joints, NCS & AS, tack & auxiliary welding, top layer of lifting lugs, trunions as specified	Δ	■	■		Δ	□	□		Δ	□	□		Δ	□	□	
	FINAL INSPECTION (The checks given below are also to be carried out before cl. 31 if PWHT is applicable.)																
38	Visual check, inside and outside, completed welds	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
39	Dimensional check	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
40	Inside cleaning (Pickling & passivation for SS eqpts.)	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
41	Completeness check	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
42	PMI, if required as per specs/drags, for materials & welds, NDT, Hardness, ferrite check if applicable,	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
43	Re-machining of sealing faces of shell flanges, girth flanges and nozzle flanges > 24", after welding and or after heat treatment, if any, as specified. Machining of all matching surfaces after PWHT / welding is preferred.	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
44	Pneumatic test of nozzle reinforcement pads / lining / Slip on Flanges	Δ	■	□		Δ	■	□		Δ	□	□		Δ	□	□	
45	Record of weld production test coupons(PTC)	Δ	■	■		Δ	■	■		Δ	■	■		-	■	■	
46	Pressure test – (Sketch approved by designer required for saddle positions of vertical vessels tested horizontally.)	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
47	Pickling, passivation (outside) as applicable.	Δ	■	■		Δ	■	□		Δ	■	□		Δ	■	□	
48	Draining and Drying, cleanliness, inside and outside, Tell tale hole plugging, assy. of earthing bolts	Δ	■	□		Δ	■	□		Δ	■	□		Δ	■	□	
49	Surface preparation & Painting / Corrosion protection, as applicable	Δ	■	■		Δ	■	■		Δ	■	□		Δ	■	□	

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50	Data of nameplate correspondence with drawing	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
51	Dowel pins, Nitrogen / transportation, saddle position, Nozzle blanking, Bolt holes & bolts thread protection, Protection of machined surfaces.	Δ	■	□		Δ	■	□		Δ	■	□		Δ	■	□	
52	Stamping of the equipment	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
53	Final Documentation, submit at final inspection	Δ	■	■	X	Δ	■	■	X	Δ	■	■	X	Δ	■	■	X
53A	Issue of IRN and clearance for dispatch	Δ	■	■	■	Δ	■	■	■	Δ	■	■	■	Δ	■	■	■
OTHER TESTS FOR HEAT EXCHANGERS																	
54	Tube to tubesheet mock up as per UNV 416-02	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
54a	Inspection of tube sheet and Baffles	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
55	Visual examination of shell inside	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	□	
56	Shell push-through gauge passing	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	□	
57	Inspection of tube bundle (Skeleton) for Core setting, Baffle spacing and orientation	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
58	Inspection of tube bundle (Final In case of floating / U-Tube type)	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	□	
59	Measuring of tube expansion, thinning % of wall thinning as specified – spot check	Δ	■	■		Δ	■	□		Δ	■	□		Δ	■	□	
60	Tube side-Open Bundle Hydrostatic test –If construction allows	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
61	Hydrostatic test – shell side (Differential pressure hydro test) if applicable. After expansion, prior to tube to tube sheet welding, if the tube sheet is clad on both side, as applicable.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
62	Hydrostatic test –Tube side hydro test final, (Stacked exchanger shall be tested in stacked condition on shell side and tube side).	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
63	Leakage test with helium (if required as per spec/drg)	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
64	PT : transition radius channel to tube sheet after pressure test	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
SPECIAL REQUIREMENT FOR HEAT EXCHANGERS																	
65	Heat exchanger tubes(DK Class acc. to GES for heat exchangers / DDS) testing requirements (Hydro test/, Eddy current test / Ultrasonic Test) as specified by Engineering dept. Refer ESA-AD6(M)	X	X	X		X	X	X		X	X	X		X	X	X	
66	Heat treatment of bent tubes, if required, acc. to standard or DDS, PT of bends if specified.	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
67	Tube to tube sheet joints test acc.to UN V416-02 part-1& DK class according to Datasheet. & Code	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	

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68	Leakage test with air / bubble formation agent, 1 st layer,	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
69	PT 1 st layer	Δ	■	■		Δ	■	□		Δ	■	■		Δ	■	■	
70	Leakage test top layer (prior to tube expansion and PT) at 1.25kg/cm2g or as specified	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
71	PT top layer (prior to expansion, after heat treatment, if specified)	Δ	■	■		Δ	■	□		Δ	■	□		Δ	■	□	
72	Leakage test helium, if specified in DDS	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
73	Final PT after expansion, visual, , after PWHT	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
SPECIAL REQUIREMENT FOR COLUMNS																	
74	Set up of TSRs & Supports for internals	Δ	□	□		Δ	□	□		Δ	□	□		Δ	□	□	
75	Inspection of TSRs & Supports for internals	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
76	Dimension Inspection on internals like trays, demisters, spargers etc.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
77	Trial assembly of internals with the equipment / dummy shell / layout as applicable	Δ	■	■		Δ	■	■		Δ	■	□		Δ	■	□	
78	Hydro test Leak test of trays / internals if applicable.	Δ	■	■		Δ	■	■		Δ	■	□		Δ	■	□	
SPECIAL TESTS FOR INTEGRALLY CLADDED, STRIP CLADDED EQPTS. (if specified in DDS, drawings and / or engineering spec.)																	
79	UT : weld overlays & clad material	Δ	□	□		Δ	□	□		Δ	□	□		Δ	□	□	
80	Note: RT/UT of the weld Joints prior & after to weld Overlay, as applicable (X for films review)	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
81	Copper sulphate test or equivalent test of Backing material prior to clad restoration.	Δ	■	■		Δ	■	■		Δ	■	■		Δ	□	□	
82	PT : weld joint after flush grinding and prior to overlay, weld overlay & welds on clad material as specified	Δ	□	□		Δ	□	□		Δ	□	□		Δ	□	□	
83	UT : clad plate(formed parts) after forming prior to heat treatment	Δ	□	□		Δ	□	□		Δ	□	□		Δ	□	□	
84	Ferrite test for welds if applicable, prior to Heat treatment, if Heat Treatment is applicable	Δ	■	■		Δ	□	□		Δ	x	x		Δ	X	X	
SPECIAL TESTS FOR EQPTS. WITH LIMPET COILS & JACKETED																	

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EQPTS																	
85	Visual, NDT clearance, surface preparation of the main shell prior to coil / jacket set up.	Δ	■	■		Δ	■	□		Δ	■	X		Δ	■	X	
86	Visual, NDT clearance, surface preparation of the coil / jacket inside surface before set-up.	Δ	■	■		Δ	■	□		Δ	■	X		Δ	■	X	
87	PT : Root run & final run of Coil to coil joints, Coil to shell, as applicable	Δ	■	■		Δ	■	□		Δ	■	X		Δ	■	X	
88	Pneumatic testing : after root run & final run of Coil to coil joints, Coil to shell, as applicable	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	
89	RT: Coil to coil joints, Jacket LS/ CS, Coil to shell as applicable.	Δ	X	X		Δ	X	X		Δ	X	X		Δ	X	X	
90	Pressure test of the Coil/ Jacketed shell	Δ	■	■		Δ	■	■		Δ	■	■		Δ	■	■	

SYMBOLS & LEGEND

- Hold point , fabrication shall be kept under hold until inspection has been performed or written clearance is obtained by vendor
- Witness Point. Advise of inspection, Fabrication may be continued if inspector is not present after invitation issued in due time.
- Δ Examination with test report
- X Review of test report – including review of RT films.
- ☼ Review documents Prior to start of fabrication or retained for information

**TPIA - Third Party Inspection Agency
PMC / Owner # - tkIS India stages of Inspection for Identified Critical Items**

LS	Longitudinal Seam	MT	Magnetic Particle Examination	DDS	Design Data Sheet
CS	Circumferential Seam	PT	Liquid Penetrant examination	t	Thickness
NCS	Shell to Nozzle Seam	UT	Ultrasonic examination	DN	Nominal Pipe size(NPS)
AS	Attachment Seam	RT	Radiographic examination		

Classification Group 1

- a. Vessels operating at a design pressure of > 150 kg/cm² g
- b. Vessels subject to fatigue loading according to ASME-Code, Sect. VIII, Div.II, AD-Merk Blatter 160

Classification Group 2

- a. Materials acc. to ASME-Code, Sec. IX, QW/QB-422 and Sec. II, Part D Table 1A, 2A, wall thickness of the cylindrical shell as indicated

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		Mfr.	LSTK Contractor	TPIA	PMC/Owner	Mfr.	LSTK Contractor	TPIA	PMC/Owner	Mfr.	LSTK Contractor	TPIA	PMC/Owner	Mfr.	LSTK Contractor	TPIA	PMC/Owner

c. Materials acc. to ASME-Code, Sec. IX, QW/QB-422 and Sect. II, Part D Table 1A, 2A, P-No. 6; 11A group 4; 11B

below :
P-No. 1 group 1 and 2; P-No. 3 group 1 and 2 > 65 mm
P-No. 1 group 3; P-No. 9A ; P-No.9B; P-No. 11A group 2 ≥ 50 mm
P-No. 1 group 4; P-No. 3 group 3; P-No. 10A ≥ 20 mm
P-No. 4 group 1; P-No. 5 group 1 and 2 ≥ 30 mm
b. Brick- or concrete-lined vessels operating at a design pressure of > 20.4 kg/cm² g.

Classification Group 3

Materials acc. to ASME-Code, Sect. IX, QW/QB-422 and Sect. II, Part D Table 1A, 2A, wall thickness of the cylindrical shell as indicated below :
P-No. 1 group 1 and 2; P-No. 3 group 1 and 2 ≥ 30 to ≤ 65 mm
P-No. 1 group 3; P-No. 9A ;P-No.9B; P-No. 11A group 1and 2 < 50 mm
P-No. 1 group 4; P-No. 3 group 3; P-No. 10A < 20 mm
P-No. 4 group 1; P-No. 5 group 1 and 2;P-No. 10C < 30 mm
P-No. 8 group 1 ≥ 30 mm
P-No.21 and 22 ≤ 50 mm

Classification Group 4

a. Materials acc. to ASME-Code, Sec.. IX, QW/QB-422 and Sec. II, Part D Table 1A, 2A, wall thickness of the cylindrical shell as indicated below :
P-No. 1 group 1 and 2; P-No. 3 group1 and 2; P-No. 8 group 1 < 30 mm
b. Atmospheric vessels

Remarks : In case of vessels and equipment for pressurized hydrogen and/or H2S- service (sour gas) and Reactor Regeneration section, at least classification group 2 shall be selected.

Remarks:-

- LSTK contractor to prepare an IITP based on this IITP, Applicable specifications, standards and codes and submit to PMC for final approval
- All requirements as per applicable Codes/ GES shall be taken care during Engineering, Material Procurement, Manufacture, Inspection and testing.
- Refer to tkIS-India standard UN2000-02 Part-I(M) for the dimension tolerance for vessels, 2100-02 – part2 (M) for heat exchangers and applicable GES (General engineering specification) for other items.
- Refer to tkIS-India std UNV416-01 & UN416-03 for welding including testing, post weld heat treatment and surface treatment.
- Refer to tkIS-India std UNV416-02 for tube to tube sheet joint welding, expansion and mock up test qualification requirements
- Refer to tkIS-India std UNV416-04 for water quality for leakage / pressure testing and flushing
- PMI shall be carried out as per 6723-EQS-331-EB-0006
- Test Ring and Test Flange shall be supplied by the vendor along with the heat exchanger as mentioned in the drawing.
- Re machining of shell flanges after welding / heat treatment shall be done as per GES.
- Chloride free pickling agents shall be used for pickling.
- All NDT as per ESA-AD6 (M)
- Wherever, grinding and welding is not possible, from other side, seam shall be welded by GTAW process with gas purging.

Plant	Client	Contract Code	Document ID	Contract No.	
MRPL Mangalore	MRPL	WSS for PFCC Flue Gas	6723-IEX-G00-EC-0001-A101	66-6723	
	Indicative Inspection and Test plan for Static Equipment - Pressure Vessels, Heat Exchangers, Columns, Reactors, Separators, Tanks, Stack, Cyclones				
					Rev

The tests indicated are general minimum requirements of tkIS-India. All Tests, as applicable, have to be performed as specified in the Order, Order Attachments, Codes, tkIS-India Specifications, Licensor's Specifications and Standards. In case of discrepancies between the Inspection Test Plan and the workshop documents Approved / Reviewed by tkIS-India/LSTK Contractor, the latter shall apply. The Manufacturer shall be responsible for the required Tests to be performed and for the inspector to be invited in due time to witness the Tests. The Manufacturer shall try to perform as many individual Tests as possible on same day, provided that the fabrication process permits such a procedure.

Sr	Activity	Inspection By															
		Classification Group 1				Classification Group 2				Classification Group 3				Classification Group 4			
		Mfr.	LSTK Contr actor	TPIA	PMC/ Owner	Mfr.	LSTK Contr actor	TPIA	PMC/ Owner	Mfr.	LSTK Contr actor	TPIA	PMC/ Owner	Mfr.	LSTK Contr actor	TPIA	PMC/ Owner

13. Any other test required due to manufacturing Process is to be carried out.
14. If any Statutory requirement is applicable for any item, the required documents shall be approved by the appropriate agency/ Statutory authority and inspection shall be carried out by the Authorized agency/Statutory agency in addition to document approval and inspection by tkIS-India/TPIA..
15. All materials and consumables shall be procured from project approved vendor list.
16. All the requirements of MRPL specification EDB0001, EDB 0002, EDB 0003, EDB 0004, EDB 0005, EDB 0006, EDB0007, EDB0008, EDB0009, EDB0010, EDB0011, EDB0012, EDB0013, EDB0014, EDB0015, tkIS India –GES Specs, as applicable shall be met. In case of conflict in statements of various specifications, code and standards the stringent requirement amongst them shall be followed
17. Hardness test for Parent metal, weld, HAZ, on Welding Procedure Qualification test piece, Production Test Coupon Plates and on Equipment, shall be carried out, if required as per GES/DDS/Approved drawings.
18. Simulation Heat Treatment shall be carried on Material, On Welding Procedure Qualification test piece and on Production test coupon Plate as per code & GES
19. All materials and consumables shall be procured from project approved vendor list.
20. Owner / PMC shall have right to inspect at any stage and 15 days' notification is required for the witness inspection, if any.



Devesh Sharma	Abhi Thomas / Sundar T.V.	Syam N.S.
Prepared by: LE	Checked by: SSP / DQAR	Approved by: HDP

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