

COSTED FACILITY DEVELOPMENT PLAN

On offshore wind
generator repair &
maintenance



Contents:

This presentation will cover:

- Risk register
- Recommendations (gap lists and registers, Process route map)
- Costs summary

Probability	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	20
	1	1	2	3	4	5
		1	2	3	4	5
	Impact					

Risk Register

ID	Date raised	Risk	Risk description	Likelihood	Impact	Severity	Mitigation action
1	22/07/2026	Intense vibration	Can cause nerve damage and blood vessel loss	2	4	8	Add vibration isolation like rubber pads to control the level of vibration
2	22/07/2026	Electrical shock	When handling with electrical application or live wires in motors	3	5	15	Where PPE like gloves
3	22/07/2026	Stored energy release	rotational forces can discharge instantly	3	5	15	Electrical proof clothes
4	22/07/2026	Physical injuries toward the body	lifting heavy equipment can cause back or spinal pain	4	4	16	Supervise and plan ahead
5	22/07/2026	Slip and trips	due to liquid on floor can create head injuries	5	3	15	Place warning signs
6	22/07/2026	Noise risk	when testing is done on generators and motor	2	4	8	Where headphones for ear protection
7	22/07/2026	Heat exchanger pressure	If failure pressure can burst causing parts to burst violently	2	5	10	Follow Lock out, Tag out
8	22/07/2026	confined space	Harmful gases and increase chance of fire in the workplace	4	4	16	Isolate <u>equipment</u> and have fire extinguishers nearby
9	22/07/2026	working at height	when using forklift accidents can occur if standing on it	1	5	5	where harness or be supervised
10	22/07/2026	Cuts towards limbs or hands	sharp items	3	3	9	Where gloves and appropriate boots
11	22/07/2026	Incomplete design	can disrupt the rest of production	2	5	10	Complete design fully

1 2	22/07/2026	inappropriate standards	can meet and follow the required legislation like environmental protection act	2	3	6	Follow iso laws and regulation including environment
1 3	22/07/2026	<u>Component mismatch</u>	Like poorly fitted magnetic wedges can cause further mechanical and electrical failures	4	5	20	take extra precaution and order more
1 4	22/07/2026	incorrect material tolerances	insulation breakdown and rapid wear	2	5	10	preplan
1 5	22/07/2026	Payment delays	disrupt and cause problems to cashflow	2	3	6	push for payment as soon as possible if not decline the offer
1 6	22/07/2026	Cost overruns	if passed budget the project will most likely be unacceptable	1	4	4	set a reasonable budget, give reminders and look for the best quality and affordable product
1 7	22/07/2026	Task completion	delay in task completion can shift all other process and task times	5	5	25	Set goal and due date
1 8	22/07/2026	Limited labour	less activity can increase production times	5	3	15	Hire and interview qualified engineers
1 9	22/07/2026	lack of equipment skill	Creates more defects and can potentially harm others	1	5	5	Provide Training
2 0	22/07/2026	Broken equipment	Costly downtime, more waste in time	4	4	16	Replace and do routine maintenance
2 1	22/07/2026	Delivery delays	Unexpected delivery delays can cause problems towards production not getting material or equipment on time	4	3	12	<u>Have a</u> backup plan

Recommendations

This section will include:

- Equipment register
 - Required skills & training list
 - Equipment gap list
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Equipment register

	Multimeter Fluke 1587	RS PRO RS5505 Insulation tester	Agilent oscilloscope U1602A-S	Ammeter CM87 AC Clamp	Castle noise meter MK141 & calibration	RS-8890 Manometer	Lexseco rotor tester	Stator lifting beam (1750kg)	Dynamic balancing machine	Purge pressurised system	Rotor sling bar (1806A)	Calibrated grease gun (Milwaukee M	Overhead crane	Bearing puller	Torque wrench
Costs	£977.00	£288.72	£1,195.00	£285.00	£2,232	£257.58	£150,000	£587.29	£30,000	£962.68	£2,249.73	£139.99	£36,000		
purchase date	2023	2025	1 year											Equipped	Equipped
Serial number	4.3E+07	2.4E+08	KR46101217	1401572	74937	190718346	-	-	-	stock No.70526204					
Brand/ supplier	Fluke	RS pro	AAA testers	Martindale Electric	RS			SafetyLiftingGear	RS/ Pepperl+F	Raptor supplies	Toolstation	Granada Cranes			

Figure 1 key :	
Expensive	=
Moderate	=
good price	=

Figure 1: Equipment Register including Gaps and costs

Process Skills:	No. of skilled workers	Training required:	Potential providers:
Rotor Winding – both induction squirrel cage and generator rotors		Internally developed skills set through apprenticeships and in-house training	City College Norwich REAGIT
High Speed and Low Speed Dynamic Balancing		Internal and external training of operating equipment	Hoffman Schenk IRD Dynamic Balancing
Stator Winding – Both mush winding and concentric diamond winding		Internally developed skills set through apprenticeships and in-house training	City College Norwich REAGIT
Impregnation of Stators/Exciter Armatures		Trained on qualified insulation systems, internal processes of various insulations systems	In-house <u>Intersolutions</u> AEV
HV Electrical Testing		External training courses on the use of HV equipment – Related to H&S courses	In-house To be investigated (using equipment such surge testing. Flash testing, Megger sets) PAR/Megger H&S – related courses
Mechanical Assembly		Internally developed skills set through apprenticeships and in-house training	City College Norwich REAGIT
Electrical Assembly – including termination of auxiliary equipment		Internally developed skills set through apprenticeships and in-house training. Additional wiring certification	IPC-620 Harness Wiring course COMPEX installation
Purge Assembly & Testing		Assembly of purge units, in-stage testing and final sign-off	Ex certification

Equipment gap list

<u>GAP LIST SCOPE</u>	<u>PRESENT EQUIPMENT</u>	<u>WHAT'S NEEDED TO OVERCOME THE GAP</u>	<u>PROCESSES STAGES</u>	<u>WHATS NEEDED TO OVERCOME THE GAP</u>
1	Purge pressurised system		Hydrogen brazing test	
2	Implementation of VIP system	Vacuum pressure impregnation	Painting facility	Gap filling
3	(5,10,30 Ton) lifting crane capabilities	Lifting heavier if necessary	Preload band	
4	Loop machines		Small wire winding	
5	LV auxiliary DRIVER (315KW pony motor)	Max is 355KW so raise the max	High voltage test	
6	HV auxiliary Driver (7000KW) (6000V-15000v)	Produce a higher max power for motor so its flexibles		
7	Insulated hydraulic compressors			

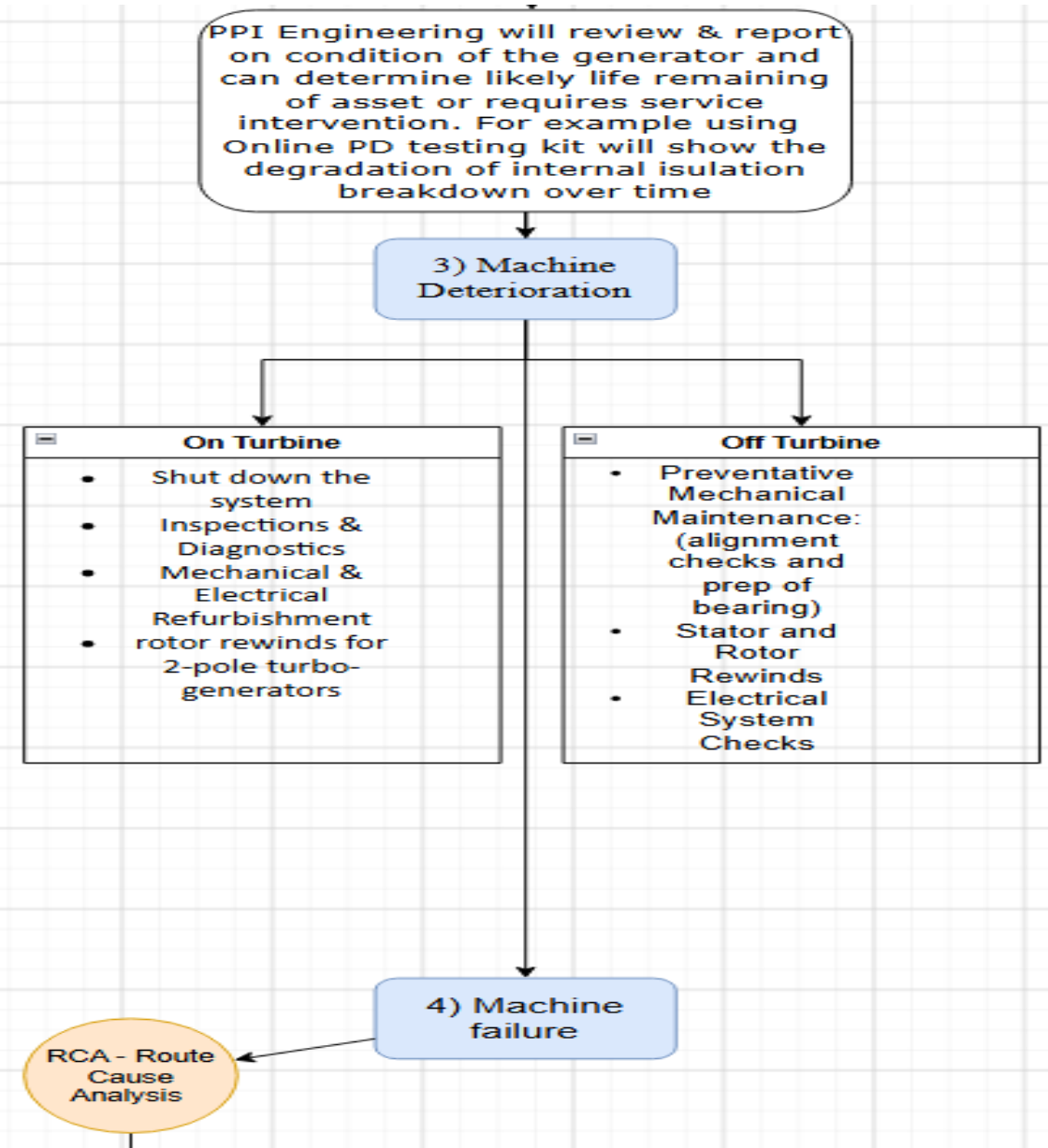
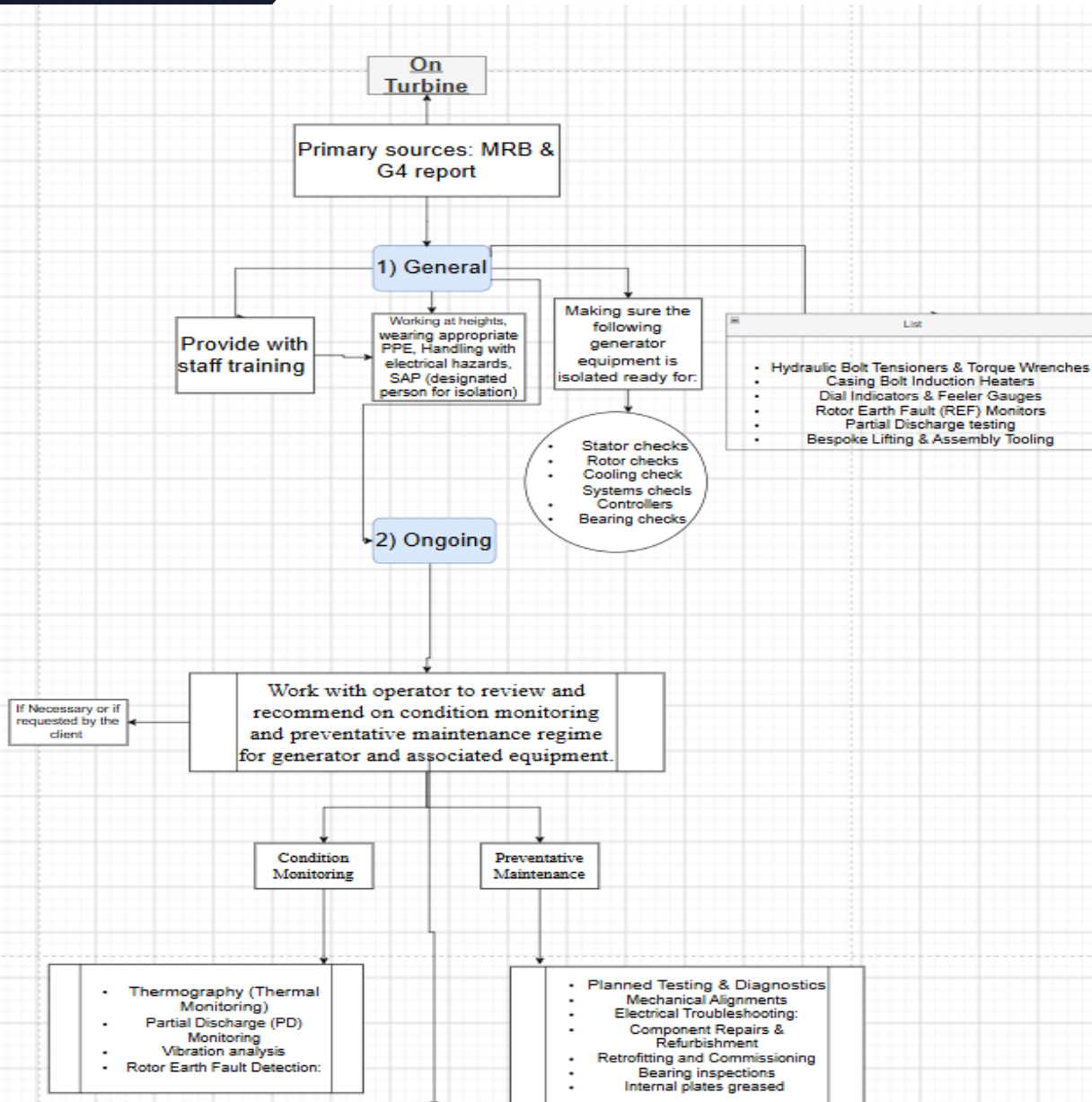
Equipment gap list

<u>Gap list scope</u>	<u>Electrical equipment</u>	<u>problem</u>	<u>Make & Model</u>	<u>capacity</u>
High current , low voltage variable supply	Multimeter	High current, low voltage variable supply	Fluke 1587	—
	Insulation tester		RS PRO RS5505	Insulation resistance up to 4 GΩ
	Agilent oscilloscope	Unrecorded dead time intervals between waveforms.	U1602A-S	200 MSA/S max sample rate
	Ammeter		CM87 AC Clamp	True RMS 0.1A to 1500A
	Castle noise meter		MK141 & calibrator	25 dB to 140 dB
	Digitron pressure indicator		S.No.510519498RC /	—
	Manometer		RS-8890/	Max Pressure capacity is 0.137

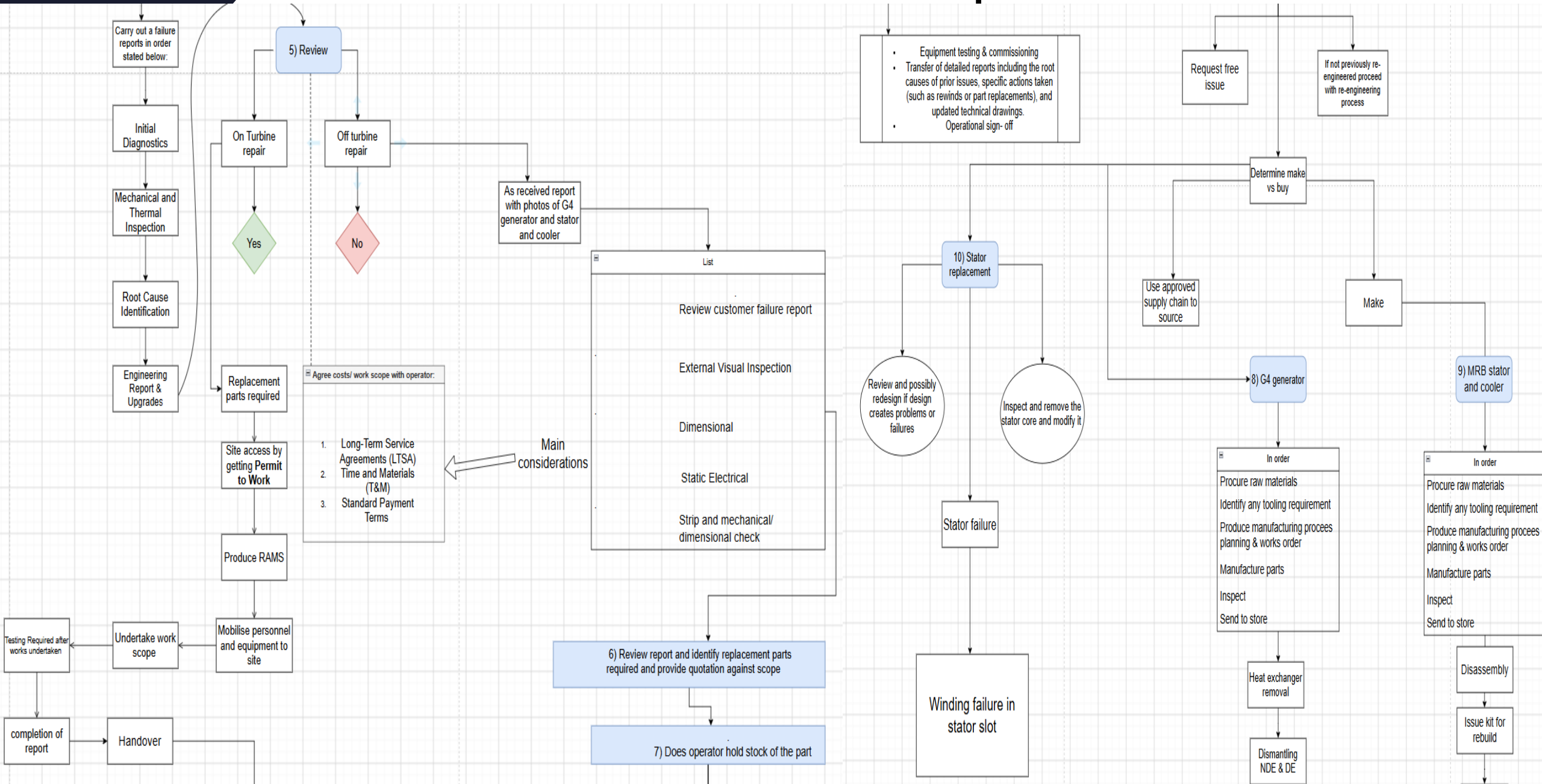
Plan analysis section

- This section will include the process route map referencing and using the MRB and G4 report as its primary sources. This shows 13 process stages starting from intake to ending with despatch, this will include stages like General, ongoing, machine deterioration, machine failure, review, review report and identify replacement parts and provide quotation against scope, does operator hold stock of the part, G4 generator, MRB stator and cooler, stator replacement, 2x going through root cause analysis, and lastly ready for dispatch. There will be a root cause analysis process three times during this project so that the main problem and replacement can be identified and performed.
 - The goal of this process route map is to give an ideal plan to PPI Engineering to go through required repair and maintenance.
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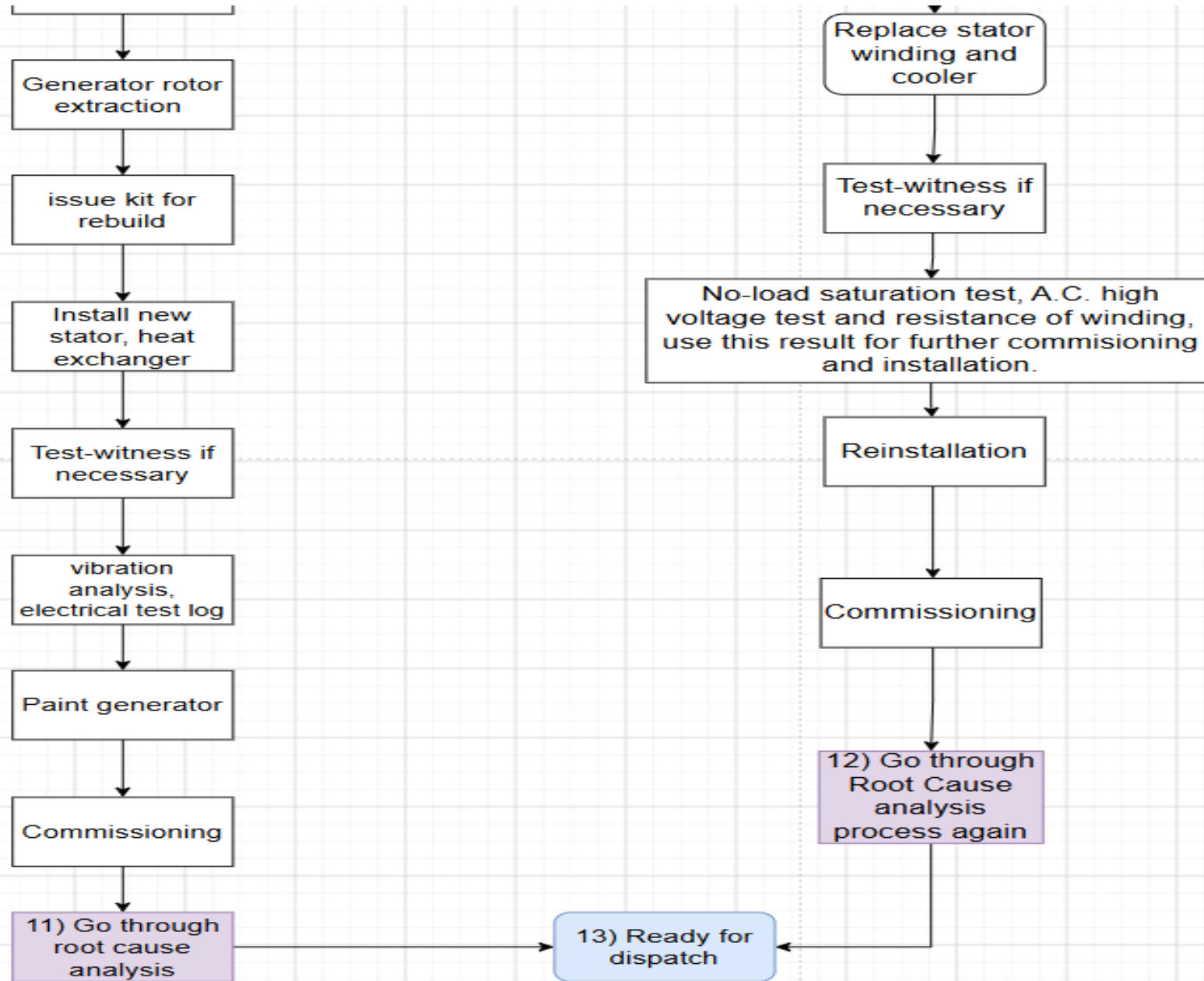
Process route map



Process route map



Process route map



Cost summary

Name of expenses		Total costs
Equipment		£225,138.31
Training		£6350.80
Subcontracted work		?
Facility modifications		£0
Total costs		£231,489.11

Conclusion

Overall, during this project there has been issues with several unknowns and challenges when investigating cost of equipment and being able to plan all proposed investigation and operations to repair and maintain 3.6MW class offshore wind generators, however PPI engineering has been able to successfully find the solution for this case by being innovative as proven by the report to be able to carry repair and replacement whilst using free space for production.

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Thank you for listening,
any question?
