Interreg North Sea Region Decom Tools
European Regional Development Fund
EUROPEAN UNION

University of Applied Sciences
HOCHSCHULE EMDEN·LEER

DECOM TOOLS

List of Process Description for Offshore Decommission

Pre-Decommissioning Marine Operations of Offshore Wind Parks

September 2020

Emden/Leer University of Applied Science

Project Acronym:	DecomTools
Reference Number:	Interreg North Sea Region
Project Number:	20180305091606
Project Title:	Eco-Innovative concepts for the end of offshore wind energy farms lifecycle
Activities and Deliverables:	List of Process Description for Offshore Decommission
Report Number:	03
Reporting Eligibility Period:	01.03.2020 – 31.08.2020
Work Package:	4
Date of Issuance:	25.09.2020

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Introduction

According to work package four of Decom Tools application, the deliverable by the name of "List of Process Description for Offshore Decommission" shall be issued. A comprehensive study in the wind industry as well as oil and gas industry has been conducted in order to provide the above-mentioned document. Evidently, there are some similarities between offshore oil and gas industry and offshore wind industry, in particular, in terms of marine operation[1]. Notwithstanding the similarities in these two industries, there are some significant differences which has profound impact notably in the logistic and supply chain. For instance, the number of installed assets in an oil and gas field normally can vary between 1 to 5 structures whereas in an offshore wind parks, the number of turbines in a wind park is approximately between 20 to 170 in 2019[2]. Furthermore, the wind turbine components are bulky due to its geometry and size. In conclusion, since the oil and gas industry is a mature industry, the authors implemented the lesson learnt and methodology which is coveted in the oil and gas industry. Then the methods and strategies are tailored into the nascent wind industry.

One of the possible measures to fulfill the objectives of Decom Tools projects is to reduce the duration of operation time of the installation and cable laying vessel. The installation vessel can be either a heavy lift vessel or jack up vessel which is equipped with heavy lift crane. During execution of marine operations, the installation and cable laying vessel play a colossal role in the decommissioning project. They are the most expensive marine equipment for the decommissioning project. Furthermore, they emit considerable level of CO_2. One method to fulfill the objectives of DecomTools project which are 20% cost reduction and 25% CO_2 emission mitigation is to reduce the working hours of mentioned vessels which lead to reduction of project cost and CO_2 emission. This can be attained by thoughtful planning, careful and elaborate preparation, and proper conduction of the entire project.

[1] Marine operation is any operation conducted using Vessels offshore, inshore or at terminals ashore (NORSOK Standard, 1995)
[2] Offshore Wind in Europe Key trends and statistics 2019 (WindEurope, 2020)

Hence, in this deliverable three different phases for the decommissioning has been devised as per figure 1. The first stage is pre-decommissioning activities (most left figure) in which the preparatory activities can be undertaken by deploying smaller and cheaper vessel equipped with remotely operated vehicle (ROV) to make the site ready for removal and decommissioning process. To put it more simply, by execution of the pre-decommissioning activities, the working hours of installation and cable laying vessel will be reduced considerably. The second stage is removal and transportation of offshore wind parks components to the onshore for further process and recycling. Finally, the last phase is post-decommissioning marine operations. In this phase by executing post-decommissioning activities which are mostly sets of survey activities, contractor carry out remaining activities and then ascertain that the removal and decommissioning has been completed successfully in accordance with project requirements and relevant codes and standards. However, it should be noted that before installation of wind park, a certain set of activities and surveys were conducted to make the site ready for the installation. The pre-decommissioning activities are not exactly similar to the pre-installation operations. Similarly, pre-installation phase was carried out to make the site ready for the installation.

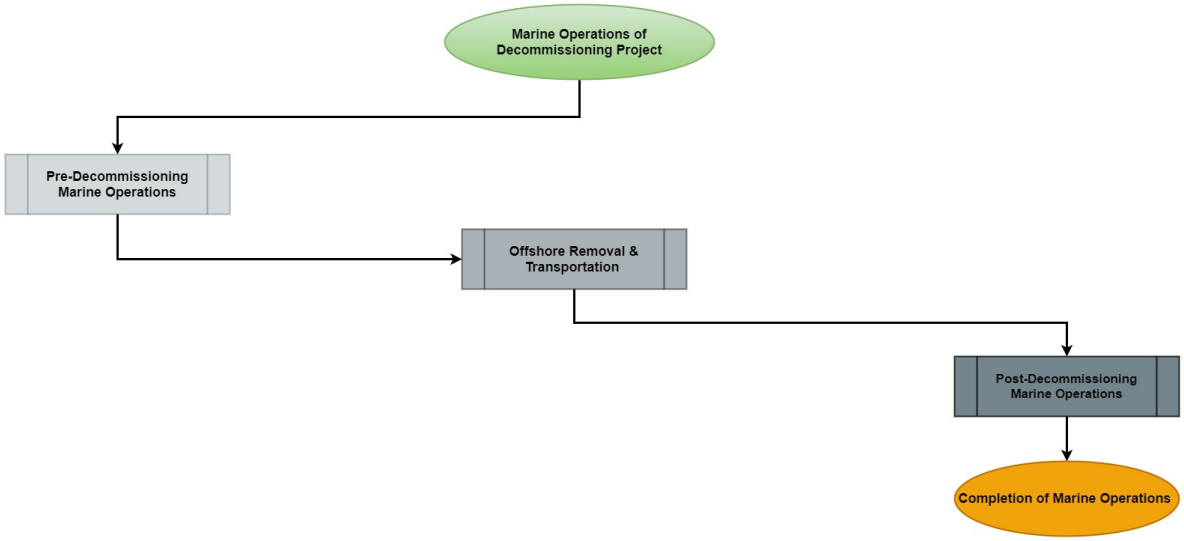

Figure 1 Sequences of Marine Operations of Decommissioning of Offshore Wind Parks

Having considered that each wind farm has different components, the required marine operations for pre-decommissioning and removal vary. These proposed activities are according to common practice, industries recommendation, codes and standards. Therefore, in the document "Pre-

Decommissioning Marine Operations of Offshore Wind Parks which is part of deliverable "List Of Process Description For Offshore Decommission" with document number "DECOMTOOLS-WP4-PDOWP-EDP-A3-001" necessary marine operations for each component has been introduced (component wise).

Based on the application, the document should illustrate the required operation in the format of even-driven-process. Therefore, the authors use the open source software by the name of Draw.io[3] in order to show the overall process of decommissioning of offshore wind parks.

As it stated above, the decommissioning operation is divided into three different phases. Therefore, for each phase a separate document is prepared. Each document has an identical name and number which is following the below principal.

Project Name-Work Package Number- abbreviation of name of Document - Document Format-Document Size- document number

DECOMTOOLS WP4 PDOWP EDP A3 001

Project name- Work package4-Pre-Decommissioning of Offshore Wind Parks-Event Driven Process-Sheet Size-Document No.

[3] Draw.io is a flexible and open source software that can show the process in even-driven format.

Pre-Decommissioning Marine Operations of Offshore Wind Parks
(List Of Process Description For Offshore Decommission)

Interreg North Sea Region Decom Tools
European Regional Development Fund

EUROPEAN UNION

Work Package Number: 04
C.5.1.1: List of Process Description for Offshore Decommission

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Pre-Decommissioning Marine Operations of Offshore Wind Parks

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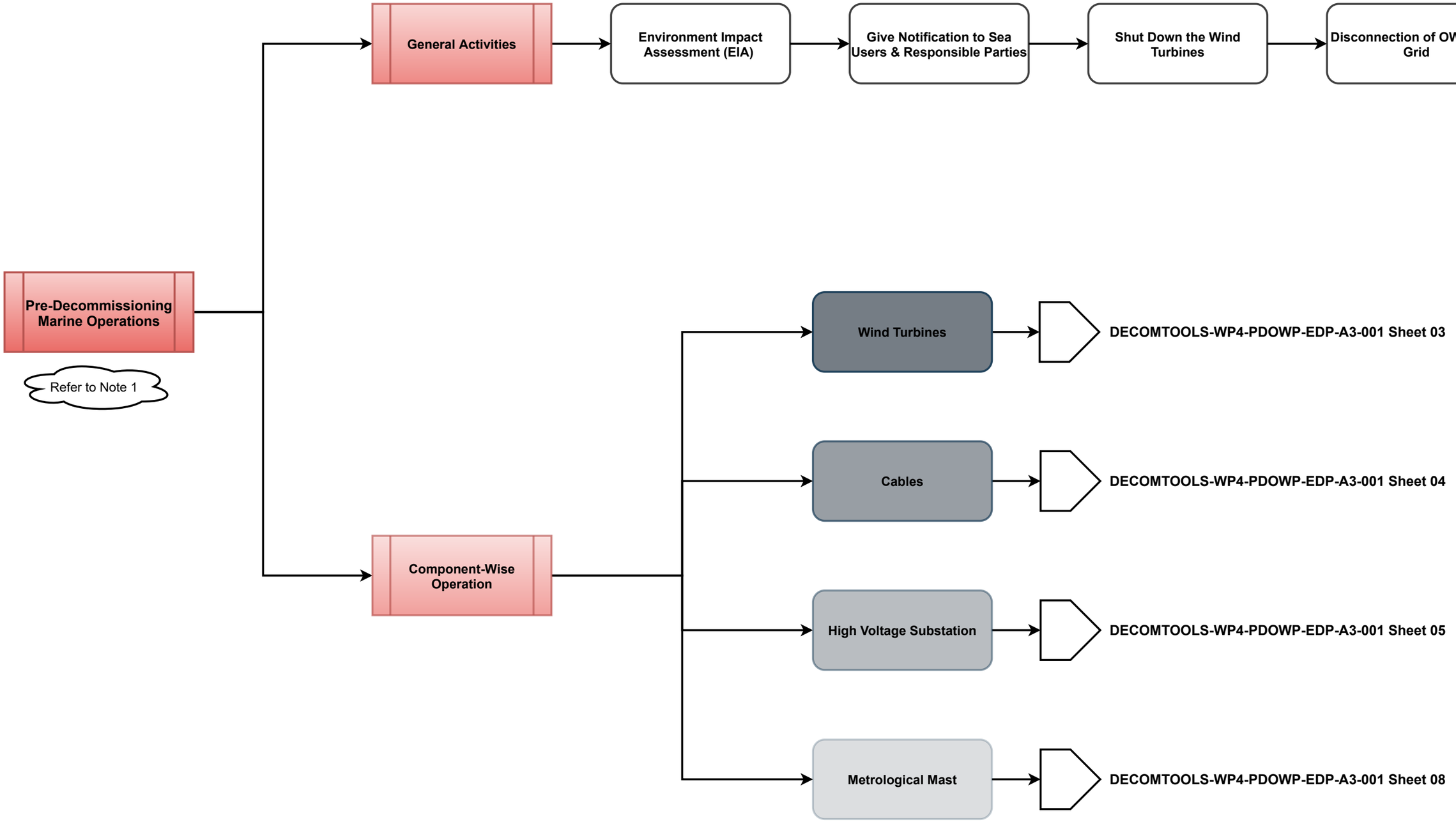
20 August 2020	**4 September 2020**	**18 September 2020**	**30 September 2020**



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Notes:

1. Prior to commencement of marine operations for offshore wind farms decommissioning, the different countries set various regulations which the developers have to fulfil them. Therefore, there is not a prescribed set of actions for all nations. For example, in the UK, the developer must undertake environmental impact assessment (EIA) and they must discuss the issue with Department of Energy and Climate Change (DECC). In Germany, the developer must devise a decommissioning concept and procedure to justify the magnitude of security. Or in Denmark, an obligation to return the site to pre-installation condition should be devised which is part of contract of developers (assessment of offshore wind farm decommissioning requirements, DNV.GL,2016). Therefore, before commencement of maritime operations, different actions need to be taken in various countries and there is not one-size-fit all measures for all nations. In this document, the required actions and operations based on common practice are shown. There are two targets to conduct pre-decommissioning maritime operations. The most important aim is to devise a practical and detailed plan for removal of structures and cables by conduction of surveys in order to mobilize a right equipment and machinery. The omission or oversight to mobilize inadequate or extra personnel and equipment will have significant impact on project time, cost and CO2 emission. Therefore, a comprehensive study of field should be undertaken. Furthermore, prior to commencement of removal operation, some measures and steps have to be implemented in order to make the wind park ready for removal of main components. These kind of operation and preparation require small vessel and specific tool which will contribute to minimizing the charter time of large WTIV and HLVs which will lead to decrease the overall cost of decommissioning.

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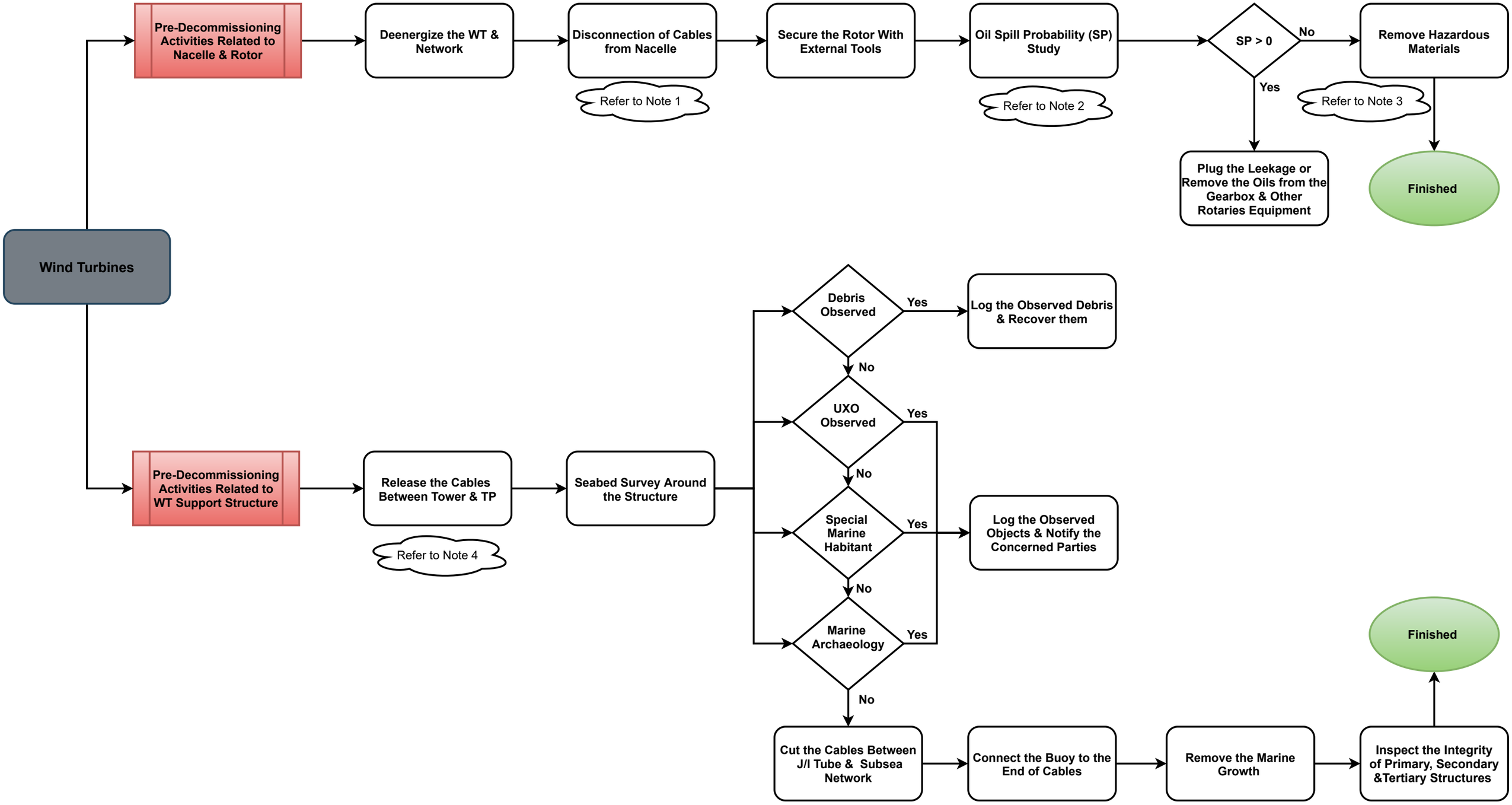

Notes.

1. Disconnection means to release the cables between the nacelle and the tower physically. In other words, in case of unbolting the nacelle from tower, there should not be any connections and cabling from Nacelle to the tower. It can be achieved by disconnection of cables from hang-off or cutting the cables and trays depending on the situation and the design of that wind turbine.
2. Depending on the wind turbine size, just the gearbox contains an oil quantity of between 200 and 800 liters (Monitoring the Oil of Wind-Turbine Gearbox, D. Coronado & J. Wenske). However, the large wind turbine gearbox need approximately over 2000 liters of oil.One of the most failure of wind turbine is gearbox failure. There is possibility to have a leakage from gearbox after reaching the lifetime of OWP. Therefore, the study and survey have to be undertaken to ascertain the zero probability of oil spill/leakage to the sea while lifting and transportation the nacelle in order to minimize the risk and hazard to the marine habitant and birds.
3. Hazardous materials can be any toxic and dangerous materials inside the nacelle including the fire, flame, smoke and gas detection systems that have nuclear source.
4. Normally one cable hang-off is located inside the transition pieces. Therefor, by disassembly of cable hang-off, the cables between transition piece and tower can be disconnected. In overall, by disconnection of cables and accessories (like cable trays) between nacelle and tower, between tower and transition piece and between transition piece and network, the structure will be ready for further disassembly and removal.

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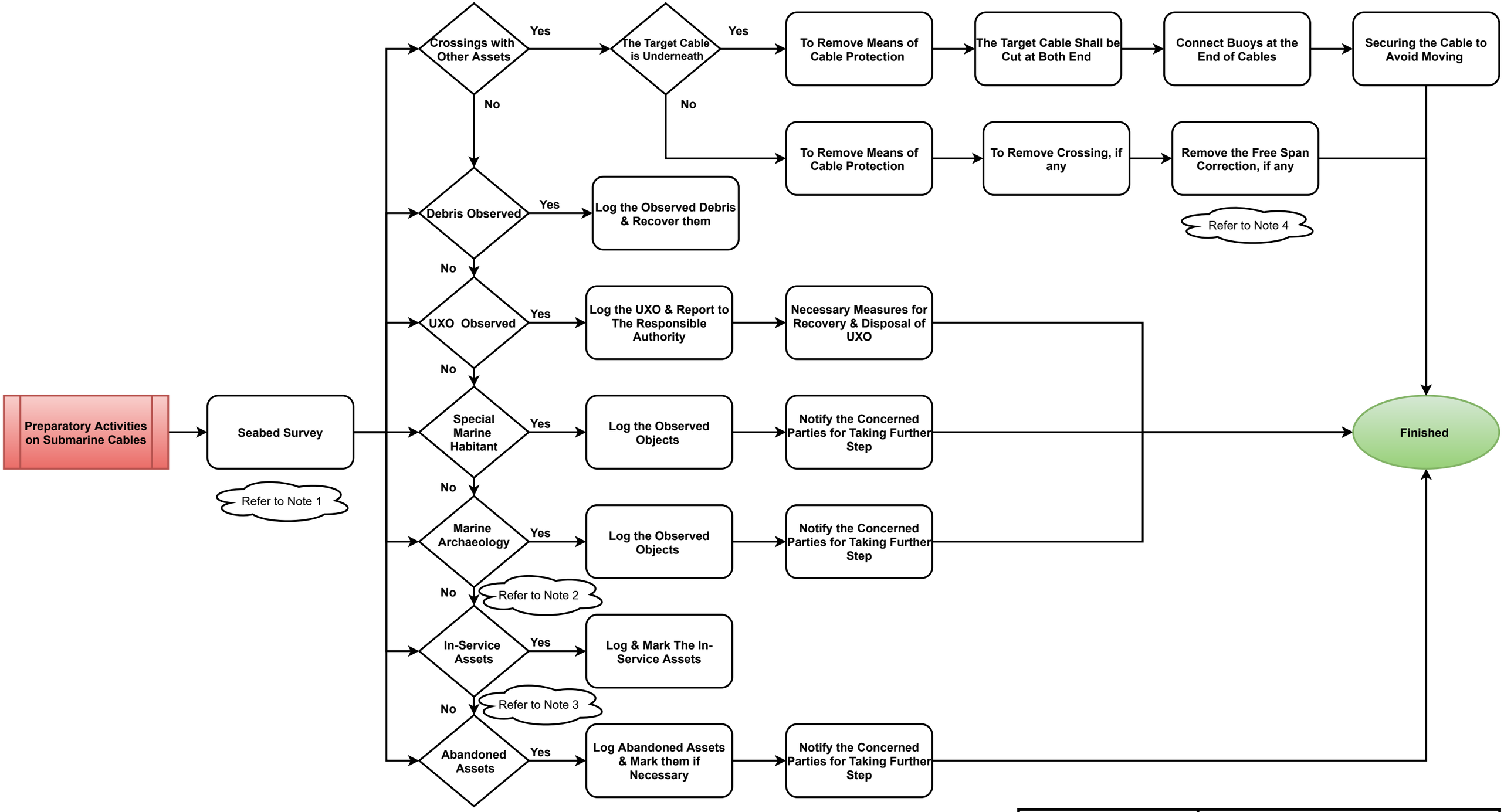
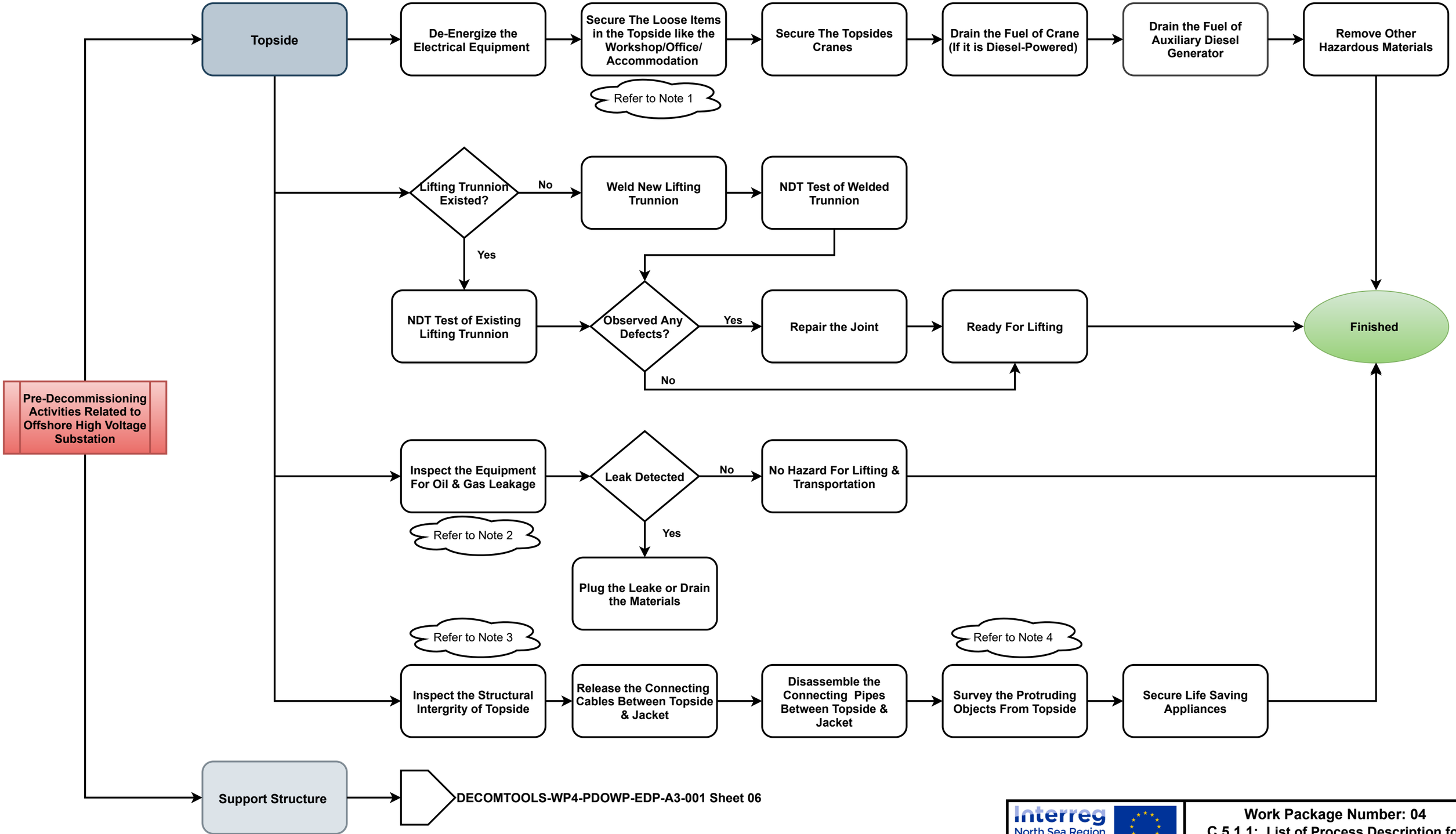


Notes:

1. The cables are normally protected by three different strategies. The first method is burying the cable for 1-2 meters below the mudline (natural backfilling). If the burial of the cable is not possible, the protection by means of tubular, mattress, sandbag and rock placement are options which is recommended by DNV-RP-J301. With any kind of non-burial protection methods, it is highly recommended to remove the protection and make the submarine cable ready for removal.
2. In-service assets are all offshore and marine infrastructure that are installed in the sea for a specific purpose. They can be pipeline, submarine cable, X-Mass trees and so on.
3. Abandoned assets can be any offshore module such as pipeline, submarine cables, x-mass tree, single point mooring (SPM or SBM) and so forth that are inoperative and disused.
4. After installation of submarine cable, as installed seabed survey shall be conducted. This survey can be done periodically during lifetime of the cable as a maintenance scheme. In case of finding free span underneath of the cable, the free span correction should take place. Normal practice for free span correction is installation of mattress, grout bags, sandbags and so forth. Therefore, after recovery of the cable, this means can be either left in situ or can be recovered, depends on the number and size of free span correction. In this document, the default scenario is full removal of the materials.



Notes:

1. Inside the offshore high voltage substation, normally, office, workshop and in some cases accommodation are existed (Ref. DNVGL-RP-0423). Therefore, in the preparatory phase, all the items inside these mentioned places should be secured.
2. Most of switchgears, busbars and transformers are oil-filled, gas-filled (SF6) or air-filled (Ref. DNVGL-RP-0423).The release or leakage of the materials from gas-filled or oil-filled equipment endanger the safety of personal and environment (Evaluation of SF6 Leakage from Gas Insulated Equipment on Electricity Networks in Great Britain,2018).Therefore, prior to lifting operation and transportation to the shore, the survey should be conducted in order to ascertain that no leakage will be occurred. Otherwise, either the leakage should be plugged or the gas or oil which are dielectric substances should be removed from the equipment based on existing regulation and manufacturer's instruction manual in order to make the safe decommissioning operation.
3. In addition to first note, the tertiary structures such as handrails and gratings should be secured, if they are loose. The inspection of fire extinguisher bottles, other safety equipment such as lifeboats, life rafts, the telecommunication devices and so forth should be undertaken to make sure none of them are loose to prevent falling during lifting operations.
4. For the lifting operation, all overhangs from the structure should be measured to ascertain during the lifting, the structure does not have any clash with the vessel structure and hull. Therefore, the survey should be conducted and measurement of all overhangs should be carried out in order to make sure that vessel can lift the structure.

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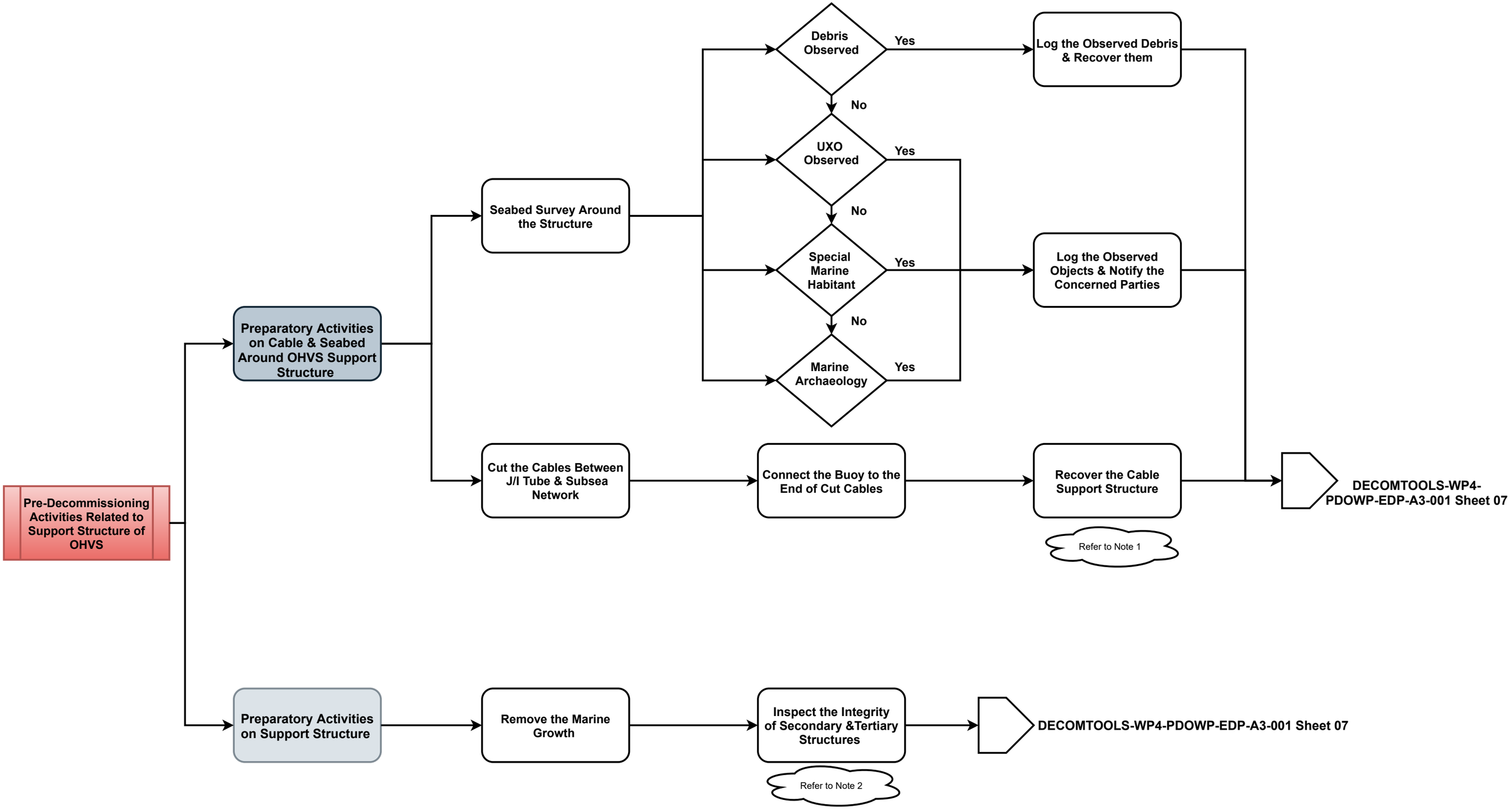

Notes:

1. At entrance point of the J-I Tube underwater, normally a structure made of concrete in a shape of pyramid is installed in order to support the weight of cable between the seabed to the J/Tube. This kind of support structure can be kept in situ or can be recovered. In this document entire removal is considered to prevent future claim from other sea users.
2. For the definition of secondary and tertiary structure, please refer to document number DECOMTOOLS-WP5-OWPPM-EDP-001-A3-01 product model, sheets 4 & 5.

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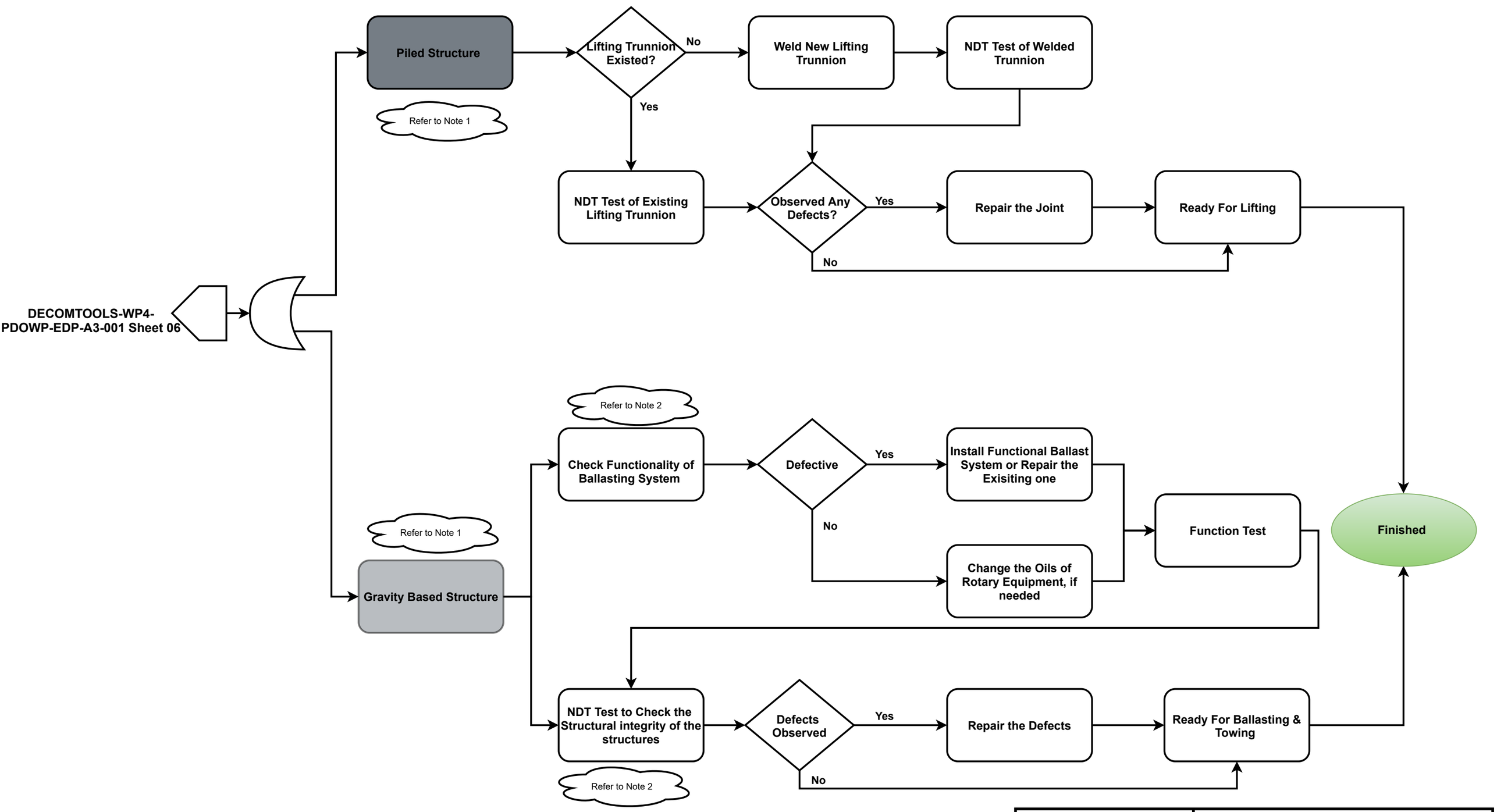

Notes:

1. The support structure of offshore high voltage substation can be installed in two different methods. Piled structure and gravity-based structure (GBS). Installation of GBS are taken place in two different methods. Some of them can be de-ballasted and refloated and others cannot. Even some of the GBS that can be refloated, due to corrosion of piping and ballasting system, new systems would have to be installed to assure the reliability of the system (Decommissioning offshore concrete platforms, prepared Atkins Process Limited and Olav Olsen A/S for the Health and Safety Executive 2003). In addition to GBS, the most installed type of piled structures is lattice type.The study in this document covers those installed GBS that can be ballasted and refloated and secondly the lattice structures.

2. Structural integrity of the concrete structures during removal could be compromised by pre-existing structural cracking and other defects which have arisen during the installations' service lives(Decommissioning offshore concrete platforms, prepared Atkins Process Limited and Olav Olsen A/S for the Health and Safety Executive 2003,p 4). Therefore, the observed crack shall be rectified to avoid accident during towage.

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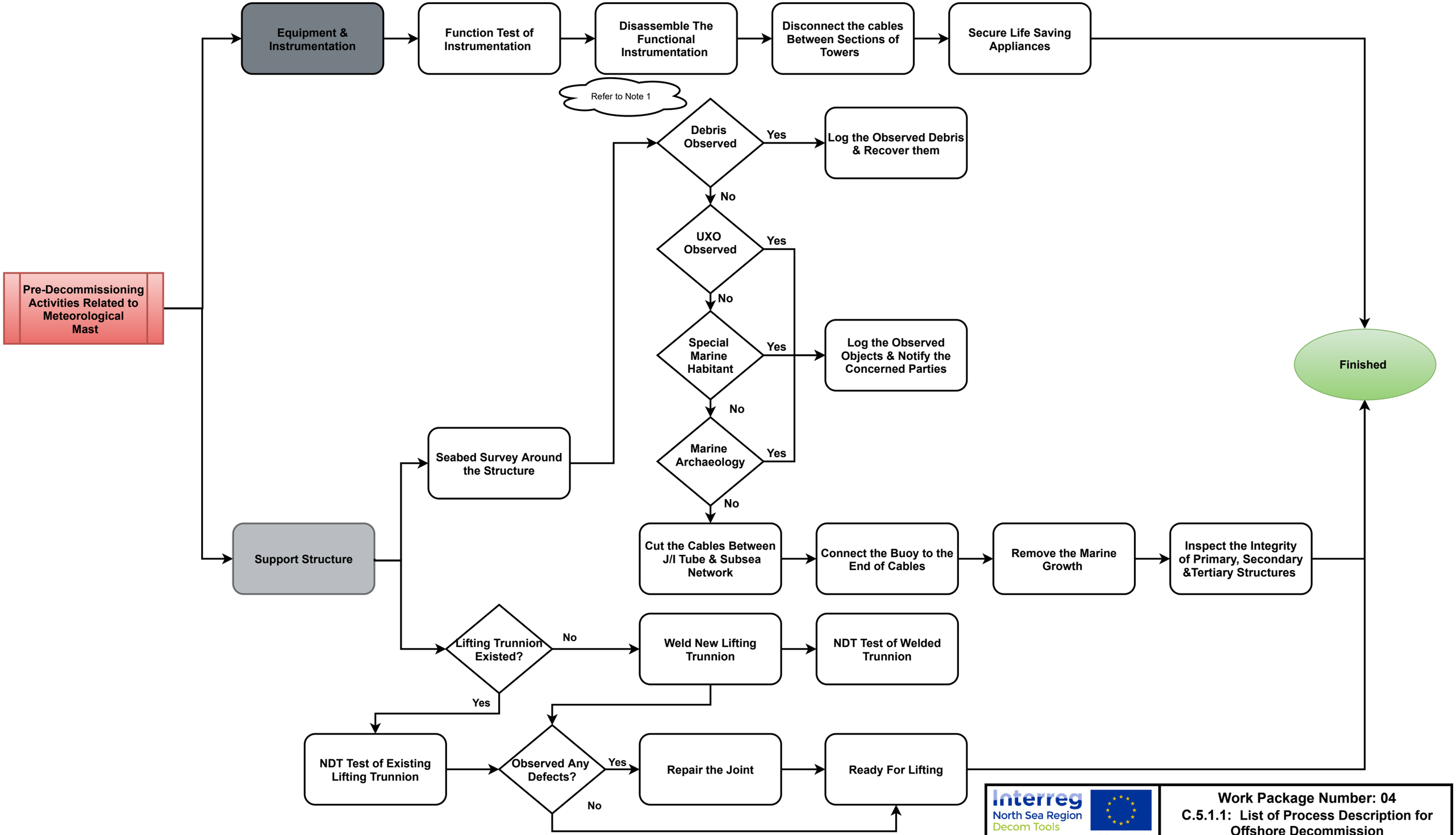

Notes:

1. All the functional instrumentation can be disassembled except the AtoN (aids to navigation) and aviation lights. This equipment shall be kept in order to prevent accident with other vessels, helicopters, aircrafts and so forth.

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