7.0 MAINTENANCE

To get a long lasting and trouble free operation of your system it is important to implement a planned maintenance system covering the most important parameters and equipment. Following a planned maintenance system will reduce the risk for expensive break down and repair. Correct operation is also an important parameter to keep the maintenance cost at an acceptable level. It is therefore important that operation instructions given are followed carefully.
For maintenance of individual pumps or components, see separate instructions in chapter 8, section 1.

Generally there are few maintenance activities on the system but we would like to highlight following:

a) Purging of cargo pump cofferdam or level control of liquid filled cofferdam according to instruction. This gives the condition of the seals in the cargo pump, and evaluations of the result enable you to plan any seal replacement. Open cofferdam on the cargo pump is important to ensure you have the barrier between the hydraulic section and cargo tank.
   A pump with a blocked cofferdam should not be used since the condition of the seals cannot be checked.
b) Do not use higher hydraulic pressure on the system than necessary. This will increase the lifetime of hydraulic components.
c) Avoid air in the hydraulic system. Vent the system regularly and always after service on the hydraulic part.
d) Mixing of different hydraulic oils should be avoided.
e) Only use genuine spare parts to ensure a trouble free operation.
f) Keep a few sets of spare seals and critical spare parts onboard if they are needed at a difficult location. Otherwise spare parts from Framo Service station are always available. The cargo seal set for cargo pumps consists of an upper and a lower seal, and both must be changed together.
g) Ensure that the portable pump is included in your planned maintenance programs. The pump must be ready when needed.
h) Move service valves annually to ensure they are operational when needed.
i) Keep the hydraulic system clean.

7.1 Maintenance / repair precautions

For safety and environmental precautions, see chapter 1.2.

If a leakage is detected, check if the flange connection is tight, retighten if necessary. If this does not stop the leak, drain and open the equipment for repair.

If the equipment does not operate properly or there is evidence of damage, overhaul the equipment in accordance with the instruction for the damaged component, or contact a Framo Service station.

Before opening the hydraulic pumps or other hydraulic driven equipment, drain the oil. Always refill with oil upon completion of the repair operation. Ensure proper air venting.

Before reassembling any parts, they must be absolutely clean and free from dirt, lint or other foreign matter. All parts must be washed in a cleaning fluid like High Aromatic White Spirit (Aromatic content 17-18%) or equal.

Note! *Do not use any cleaning fluid containing chlorinated hydrocarbons.*

All o-rings and gaskets must be carefully examined for cuts or other damage. Replace any damaged parts.

7.2 Periodical maintenance

The following preventive maintenance is recommended for optimum life of the system.

FILTER REPLACEMENT

Filter element should be replaced by a new element after indication of high differential pressure or if a contamination level of the hydraulic oil above 16/12 according to ISO 4406 has been indicated (see also item 7.3.2).

HYDRAULIC OIL COOLER

If anodes are installed (see separate instruction), inspect anodes regularly until rate of consumption is established.

Recommended intervals:
- Coolers with sea water every 3 months.
- Coolers with fresh water: annually.

The cooler bundle tubes should be cleaned regularly with soft brush or chemicals to remove fouling film or solid contamination.
Recommended intervals:
- Coolers with sea water every 6 months, or if heat exchange rate is too low.
- Annually for coolers with fresh water, or if heat exchange rate is too low.

ANODES

Inspection intervals for the zinc anodes assembled on ballast pumps and other pumps depends mainly on time of exposure, water level in tank, water corrosivity and temperature.
Please note that the anodes included by Framo are only intended for protection of the pump, not the tank.

Our standard calculation of anode lifetime is based upon:
- 100% exposure in seawater
- Current density when exposed in seawater: 0,1 A/m²
- Zinc anode electrochemical capacity: 780 Ah/kg

It is recommended to inspect the anodes annually until rate of consumption is established. Further inspection intervals to be based on experience.

RUBBER ELEMENTS IN FLEXIBLE COUPLINGS

When a hydraulic pump or an electric motor is dismantled for maintenance and repair, the rubber elements in the flexible coupling must be replaced.

STAINLESS STEEL ON DECK

Soot and dust, in addition to humidity and chloride concentrations present in the marine atmosphere may affect both the corrosion resistance and the visual impression of the stainless steel surface unless it is cleaned regularly.

The cleaning can be done either by chemicals or mechanically.

- For chemical cleaning the following products are recommended: Unitor-Metalbrite HD Cleaner or Avesta Pickling Paste.
  Note! *All safety instructions from supplier must be carefully followed during work.*
- For mechanical cleaning, use grinding by rotating abrasive paper or a stainless wire brush. Finally, the material surface should be well cleaned by use of solvent cleaning.

For equipment which is painted a brush-up painting may be necessary.

OIL TESTING

To verify that the oil is in good condition, samples to be taken on a regular basis and according to separate instruction. Particle counting and water analyses every 3 months, and full oil analyses once a year.
Framo oil monitoring program cover this activity and can be offered upon request.
All samples to be taken at Framo oil sampling point.

OIL LEVEL INSPECTION

Part of the alarm system. Abnormal difference in oil level when power system is stopped or in running condition means air in the hydraulic oil (high level when power packs are stopped, low level when they are running).
Vent the system regularly until the air is out of the system.

NOISE FROM PUMP/MOTOR

When in operation. Normally indicates that further analysis is required.

PURGING OF CARGO PUMPS

Purging of cargo pumps to be done in accordance with separate purging instruction.
Purging reports to be filled in during every round-trip and to be returned to Framo Services AS.
E-mail purging form to address autopurging@framo.no will ensure an efficient transmittal. Framo will evaluate the results and give further advice if needed.

HYDRAULIC OIL LEAKAGE INSPECTION

When in operation.

DEBRIS SWITCHES (ELECTRICAL) AND DETECTORS (MANUAL)

Debris switches to be checked if alarm is indicated.
Debris detectors (if installed) to be checked every 3 months.

FEED PUMPS / JOCKEY PUMP

Spiders for feed pumps and jockey pump coupling must be replaced at 5 years intervals.

7.3 Condition based maintenance

This part describes action to be taken when following conditions occurs:

- Alarm "Wear indication"
- Alarm "Main filter dirty"
- High contamination level in oil
- Wear on cargo pump wear ring

7.3.1 WEAR INDICATION

Contact in the debris switch gives alarm "Wear indication". This means that the drain line to tank is contaminated by magnetic particles due to:

- Contamination from piping, components or from oil filling.
- Filter by-passing because of contaminated filter or open by-pass valves.
- Wear on pump's bearings and/or rotary group.

Action to be taken:

- Inspect the debris switch and make a note for eventual later trouble shooting with date, power pack running hours, and a description of the actual particles, (single particle, low number of small particles or very small mud-like particles).
- Clean the debris switch and re-insert.
- Check debris switches for the other pumps. If also these switches have similar particles, the most probable reason is contamination from piping, components or oil filling. Especially in the "run-in period" this may be the reason.
- If "Wear indication" alarm is repeated for the same pump without alarms on the other, bearings and rotary group have to be checked and replaced if necessary.
- Contact one of Framo Service Stations for further assistance.

7.3.2 MAIN FILTER DIRTY

Alarm "Main filter dirty" means that the filter element must be replaced. This alarm is activated if the oil temperature is above 30°C and pressure drop through the filter is too high (see instrument list in the hydraulic diagram).

If filter contamination occurs frequently, following actions must be taken:

- Check actual pressure drop through the filter (use a manometer from the Framo test kit).
- Send oil sample to one of Framo Service Stations, or to an oil company for analysis. If the oil sample is tested by Framo, further action will be advised.

7.3.3 HIGH CONTAMINATION LEVEL IN OIL

If results from testing show high contamination level in oil:

- Check main filter element and its by-pass valves.
- Contact one of Framo Service Stations.

7.3.4 CARGO PUMP WEAR RING

Rate of wear on the cargo pump wear rings depend on the type of cargo and also the running hours. Normally this is indicated by poor stripping performance and problems related to parallel pumping. Further analyses can be carried out by testing the cargo pump against closed discharge valve. This test requires calibrated manometers and accurate measurements. We recommend this test to be carried out and analysed by a Framo service engineer either at a predocking inspection or special attendance for this activity. Worn wear rings will increase the discharge time. It is therefore recommended to change wear rings if the pump is overhauled for other reasons.