Pumped Storage (2014) Ltd.

PSPP MANARA

ISRAEL

VOLUME 2

SECTION II

Owners Requirements

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REVISION NUMBER

1.0 First edition
1.1 Small adaptation's in chapter: 6.5.1 and 8.2.3 (gas added)
1.2 Added comments of Electra in several chapters
1.3 Adopted Header in chapter 7
1.4 Change wording in paragraph grouting (chapter 5.5; page 66)
2.0 Update with new upper and lower reservoir (Nowotny/Reisenbichler, 03.12.2020)
2.1 Minor corrections (Nowotny 14.12.2020)
2.2 Minor corrections (Nowotny 15.01.2021)

1 DISCLAIMER

Notwithstanding anything to the contrary in this document or any other RFP Document, the Design and Works and Services (as applicable) shall be done and executed in compliance with and shall adhere to the Israeli applicable standards. Compliance with an applicable recognized international standard shall not in any way derogate from the above requirement to comply at all times with the Israeli applicable standards. In the event that no Israeli standard is applicable the Design and Works and Services (as applicable) shall be done and executed in compliance and shall adhere to the relevant standard specified in the list included in the general specifications (Volume 2 Section IV, Section VI of the RFP Documents).

2 DEFINITIONS, LANGUAGE AND INTERNAL PRIORITY

2.1 DEFINITIONS

In the Owner's Requirements, the following capitalized terms shall have the meaning ascribed to them below, unless the content and context require otherwise:

Agreement or **EPC Contract**	The EPC Agreement between the Owner and the Contractor, which concerns the execution of the Works.
Contractor or **EPC Contractor**	[]
Contractor Work Plan	The work plan to be prepared by the Contractor in accordance with the provisions of Section 6.7.2.1
FSL or **Full Supply Level**	The maximum normal operating level of each reservoir. The upper limit of active storage
Law	As defined under the Agreement.
Lenders	As defined under the Agreement.
Management Information System or **MIS**	Shall be defined under the Contractor Work Plan.
MOL or **Minimum Operating Level**	The lowest level to which each reservoir is drawn down under normal operating conditions. The lower limit of active storage.
Owner or **SPC**	Ellomay Pumped Storage (2014) Ltd. or any substituting entity which the Lenders may appoint.
PSPP	Pumped Storage Power Plant.
RFP Documents	Request for Proposal (RFP) documents as defined under section 5 in the RFP
Works or **Construction Works**	As defined under the Agreement.

All other capitalized terms in this Owner's Requirements, shall be interpreted in accordance with the meaning ascribed thereto in the Agreement and RFP Documents.

Capitalized terms used in this Owner's Requirements, which are not defined in this Owner's Requirements nor the Agreement, shall be read as if they are not capitalized (i.e.: written in lower-case).

Clarification: Any statement in the Owners Requirements as “Contractor shall do / make / prepare / coordinate / etc.” means, that he shall do so at his expense, unless explicitly stipulated otherwise in the EPC Contract.

2.2 LANGUAGE

The language in the Project execution shall be English and all of the correspondence between the Parties in connection therewith shall be in English, unless the Parties agree otherwise.

3 SCOPE OF WORK

3.1 INTRUDUCTION

The Israeli Electricity Authority, established under the Electricity Sector Law, 5756-1996 (the "IEA") has decided to increase the instantaneous power available on the grid by adding PSPPs to the existing generation capacity.

Ellomay Pumped Storage (2014) Limited is a private investor that is developing the Manara pumped storage plant project.

The EPC has to design a PSPP that includes all equipment and civil works elements that is capable of producing:

- 156 MW for the current works, with a dedicated runner and fulfilling all regulation and this Owner's Requirements document regarding the 156 MW PSPP
- 220 MW with a dedicated runner and fulfilling all regulation and this Owner's Requirements document regarding the 220 MW PSPP

For the two capacity layouts of the plant (namely the 156 MW mode and the 220MW optional mode) initially 1 runner for 156 MW shall be provided together with detail engineering for the 220 MW runner. The manufacturing and delivering of the 220 MW runner shall be done as option after an additional order from the Owner. That is to say the 156 MW (turbine mode) runner shall be installed, and only after and subject to the allocation of additional quota, receipt of all required consents, approvals and permits, and the Owner’s exercise of its option to increase the installed capacity, this runner shall be exchanged via the draft tube cone with the 220 MW runner. Both runners shall fulfil all requirements stated herein.

The project performance has to comply with IEA regulations for PSPPs, and with all relevant applicable law.

It is hereby clarified that all Owner's requirements specified hereunder, shall be in addition to any applicable requirements under the Law and are not intended to derogate from any of them nor to replace them. It is the sole responsibility of the Contractor to carry out all works and services in full compliance with all applicable law and regulations.

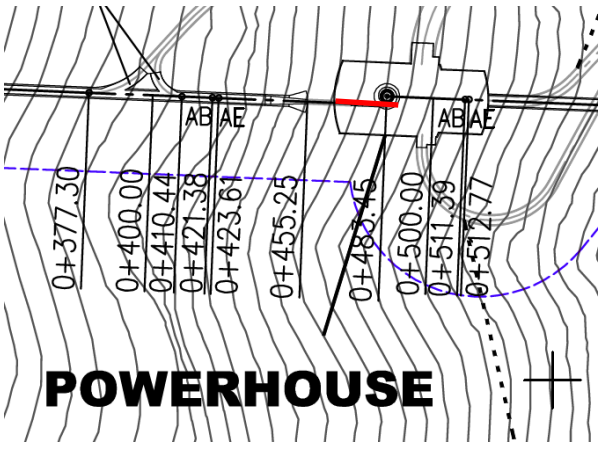
It is further hereby clarified that any non-objection/approval made by the Owner shall not, in any way, release the Contractor from any of its responsibilities and liabilities, nor shall it impose any obligation or responsibility on the Owner which fully relies on the Contractor's expertise. It is further clarified that in any event of Owner's reservations and/or comments, it shall be the sole responsibility of the Contractor to recheck and confirm any such comment.

This document has to be read with all other RFP Documents.

3.2 SCOPE OF WORK OVERVIEW

The Manara Pumped Storage Project includes, but is not limited to:

1. Upper reservoir of 1.16 Mio. m³ active storage:
   - Reservoir stripping, excavation, filling and treatment
   - Rock Fill Dam
   - Reservoir sealing with PVC foil or asphalt
   - Reservoir drainage system
   - Bottom outlet with valves and impact basin
   - Operation building (7.20*2.85m)
   - Access road, road at dam base and fences
   - Initial impounding
2. Power waterway (PWW):
   - Upper intake with trash rack, roller gate (able for emergency closure) and stop logs
   - A vertical High Pressure (HP) shaft of approximately 659.6 m height and 3.0 m inner diameter. Steel lined along the whole length.
   - A horizontal HP tunnel of approximately 474.2 m length and 3.0 m inner diameter. Steel lined along the whole length including backfill concreting between the steel pipe and the rock and grout injection afterwards.
   - A steel lined HP manifold (Part from fixpoint with cone till main inlet valve; see drawing below red line).



   - An LP tunnel of approximately 1524 m length and 3.8 m inner diameter. The LP tunnel is concrete lined with thickness of 40 cm along the whole length including grout injection works.

- As an alternative solution steel lining embedded in backfill concrete of the LPT can be chosen. The inner diameter can be reduced to according to better hydraulic conditions.
- A throttled surge tank with a vertical shaft and one horizontal chamber
- A access and aeration tunnel to the surge tank connected to the main access tunnel, approximately 419.8 m long
- At least one flexible joint cavern including a flexible joint element and a access tunnel to this chamber, approximately 211.4 m long
- Lower intake with trash rack, roller gate (able for emergency closure) and stop logs

3. Underground powerhouse (cavern):
   - Housing the pumpturbine and motorgenerator, the main inlet valve (MIV), the draft tube gate, the main power transformer, the common starting equipment (Static Frequency Converter) and all associated equipment
   - Cranes and hoisting systems
   - All other building equipment such as HVAC, drainage, firefighting equipment.
   - Architectural finishing
4. Main Access Tunnel (MAT):
   - Approximately 1350 m long
   - Pavement concrete or asphaltic-concrete
   - Housing one set of 161 kV cables to the outdoor substation, the escape way, fresh air supply and smoke extraction channels
   - Ventilation system
   - Main cavern dewatering pipe and several other pipes and cables for the cavern supply
   - An additional escape Tunnel, approximately 153.5 m long
5. Lower reservoir of 1.20 Mio. m³ active storage:
   - Reservoir stripping, excavation, filling and treatment
   - The stripped / excavated material has to be dried and conveyed to an approved dedicated waste location in accordance with any applicable law
   - Rock Fill Dam

- Levelling fill of the reservoir bottom with excavation material from existing reservoir dam, tunnels / cavern and upper reservoir.
- Reservoir sealing with asphalt or PVC
- Reservoir drainage system
- Bottom outlet with valves and impact basin
- Access road, road at dam base and fences
- Initial impounding

6. A 161 kV outdoor substation for connection to the Israel Electric Corporation (IECo) transmission grid:
   - Excavation and treatment for the substation area
   - Substation equipment for two switchboards
   - Foundations, channels, Pylons for the whole substation
   - One switchyard operation building (583 m²) inside the premises of the sub-station, including all secondary equipment for the entire switchyard which is under the operational responsibility of the IECo and the Owner
   - One control/operation building (460 m²) at the entrance of the site, and such control/operation building will also serve as a visitors centre, as will be determined by the Owner in a Variation Order
   - Emergency diesel generator
   - One guard house (52 m²)
   - Surrounding fences at the whole switchyard area
   - An electrical gate and
   - Access road, road to the MAT and car parking area
7. All relevant SCADA and communication equipment required for the overall monitoring and control of the power plant including the management of interfaces with external systems (IECo and Owner’s office)
8. All other ancillary buildings and facilities of the project including the water supply pipes, situated within the site and all access roads which may be required for accessing the site for the sake of executing the works, and long-term operation and maintenance. Project –dedicated water supply pipes may exist outside the site and their handling should be coordinated with the Water Supplier

9. In order to implement the project, a temporary work site will be built. The main construction site will be located at the site switchyard, MAT portal and the technical area according to laydown area building permit as detailed in chapter 6.5 below. The construction site will be built by the EPC for the use of all EPC Sub-Contractors, the EPC site management and the Owner, and will be fully demobilized after the commissioning of the project and its area shall be restored to its original conditions
10. The detail design of all civil, hydro-mechanical and electromechanical works of the pump storage power plant and the switchyard

The above scope represents an overview of the Project. A division of the PSPP Manara construction into different contracts is not foreseen. Therefore the construction has to be executed **by one EPC Contractor**.

The Owner's requirements provides an overview of the scope of work to be provided. Additional general and particular design issues in other Basic Design reports, drawings and specifications need to be considered.

3.3 DETAILS TO SCOPE OF WORK

The following are specifications of main works and equipment that are to be provided for the PSPP Manara Project:

3.3.1 Project Design and Site Management

The EPC Contractor shall establish and maintain an experienced team for managing the overall power plant project, including in respect of

- Project organization,
- Project construction progress,
- Design and
- Site, testing and commissioning management

3.3.2 Detail Design

The EPC Contractor shall be responsible for all detail design works of the Project such as:

- Design of all civil parts as dam engineering, excavation and support design of surface excavation and underground excavation, concrete works in reservoirs, power water ways, powerhouse, tunnels and switchyard.
- Hydro-mechanical engineering for gates, trash-racks, penstocks …
- Electro-mechanical engineering for valves, pumpturbines, motor-generator, transformer and all associated facilities as well as the switchyard.
- All other design works auxiliary equipment such as drainage, HVAC, fire-fighting equipment, ect.
- The design shall comply with the OR, Israeli standards and regulations and shall be approved by an Israeli authorized Structural Engineer or Electrical Engineer

3.3.3 Coordination with National and Local Authorities

To be in line with the National Building Requirements and other requirements under the Law, the EPC Contractor shall coordinate its design with the Local Authorities (including without limitation Israeli Fire Brigade, Israel Electric Corporation, the committee of design and building etc.) and providing, if requested by the authority, dedicated Technical Reports and other documents and information for Authority´s approval of the design. E.g. for:

- Transmission Grid System Operator

- Firefighting and Emergency system
- Electrical & Mechanical Building Service
- Construction and Civil issues
- Sewage disposal, drainage
- Safety regulations in construction works
- Regulations re-handling of explosives
- Other activities as required under the EPC Contract.

3.3.4 Interfaces

The EPC Contractor shall be responsible for all interfaces between its Sub-Contractors such as:

- All civil Contractors (earth works, sealing works, tunnelling works, concrete works, etc.)
- All hydro mechanical equipment (gates, racks, etc.) suppliers
- All electromechanical equipment (pumpturbine, valve, motorgenerator, transformer etc.) suppliers
- All suppliers for HVAC, firefighting, etc.)
- Switchyard civil and electromechanical equipment suppliers
- Grid connection

3.3.5 Site installation

The EPC Contractor shall be responsible for providing all site facilities required for the performance of the Contract such as:

- Mobilization
- Fully functional offices for his own use and the use of the sub-Contractors
- Offices for the use of the Owner (60m²)
- Operation of a dining room for the work site
- First aid facilities for the work sites
- Workshops for all materials and equipment to be supplied
- Security of the work, installations and camp areas
- Supply of electricity for all camps, offices, workshops, etc.
- Water supply and waste water treatment
- Waste disposal according to local regulations

- Demobilisation and clearance of the site after finishing the work and rehabilitate it to its original condition.

3.3.6 Dams, reservoirs and power waterways

Broad scope of works shall cover the design, excavation and fill works, civil works, engineering, equipment, installation and testing & commissioning of the items listed in the main chapter 3.2 in point 1, 2 and 5.

The following main features have to be provided with installations and equipment:

- Dam body
- Bottom outlet
  - Including regulating and revision valves
- Power intake
  - Including emergency roller gates, stop logs and trash racks
- Power waterway
  - Steel and concrete lining
  - Steel lined manifold
- Expansion joint
  - At least one expansion joint is expected. Total number of expansion joints is depending on encountered active faults during excavation of the low pressure tunnel

The following equipment and installations have to be provided:

- Medium voltage power connection
- Auxiliary transformers and related equipment
- Local electrical distribution to all equipment and installations
- Communications connection to powerhouse complex
- Communication connections to interfaces of instrumentation as:
  - Water level measurement
  - Power intake and dam instrumentation
  - Leakage information
- Implementation of instrumentation readout in the power plant control system
- Communication connections to interfaces of equipment of other lots:
- Local control equipment and implementation of remote control of equipment in the power plant control system

- Grounding, lightening protection
- Fire alarm systems
- CCTV
- Illumination
- Dewatering pumps and associated piping
- Ventilation
- Monitoring systems of the reservoirs, the powerhouse, the waterways, the tunnels etc.
- Fence surrounding both reservoirs including an electrical gate

3.3.7 Powerhouse complex and main access tunnel

Broad scope of works shall cover the design, excavation works, civil works, engineering, manufacture, supply, testing before despatch, packing, transporting to site, storage, material handling and complete erection, installation, testing & commissioning of items listed in the main chapter 3.2 in point 3 and 4).

The following equipment and installations have to be provided:

- Main inlet valve incl. pressure system and bypass pipes (2)
- Main Unit Electromechanical Equipment:
    - Pump-turbine-motor-generator set complete with, pump-turbine governing equipment & pressure oil system, compressed air system, cooling water system, drainage & dewatering system, generator excitation system & AVR and miscellaneous electromechanical equipment such as unit control board, hydraulic protection system etc.
- Draft tube gate incl. pressure system and bypass pipe
- Electrical equipment:
    - Motor-generator main circuit for the unit consisting of: neutral grounding cubicle & line terminals,
    - Surge arrester/voltage transformer cubicle and isolated phase bus duct etc.
    - Unit transformer and station-service transformers etc.
    - 161 kV cables for connecting the switchyard
    - Static Frequency Converter (SFC)
    - Medium voltage switchgear
    - AC and DC, UPS systems

  - Grounding and lightening protection system
  - Diesel Generator (placed at switchyard area)
  - Relay protection system, control & metering system etc.
  - Powerhouse illumination and small power installations
  - All power and control cabling
  - All security and communication equipment
  - Electrical workshop equipment
- Mechanical Equipment:
  - Main machine hall bridge crane, auxiliary crane, transformer bridge crane and all other hoisting systems
  - Elevator
  - HVAC system
  - Firefighting system
  - Low compressed air system
  - Mechanical Balance of Plant
  - Common plant auxiliaries
  - Access platforms and ladders
  - Mechanical workshop equipment
  - Drainage system, including pumps, pits , etc.
- Power plant Control System:
  - Computerized control and monitoring system for the entire PSPP
- Spare parts in accordance with the EPC Contract.
- Furniture, warehouse and indoor facilities (Tables, Chairs cupboards, etc.)

3.3.8 161kV Switchyard

Broad scope of works shall cover the design, excavation works, civil works, engineering, manufacture, supply, testing before despatch, packing, transporting to site, storage, material handling and complete erection, installation, testing & commissioning of items listed in the main chapter 3.2 in point 6).

- 161 kV switchyard with all auxiliaries and service equipment, as well as pylons cable channels and foundations
- Grounding and lightning system
- Firefighting system
- CCTV

- Electrical & mechanical building services
- HVAC system
- MV Panels
- Battery system for the plant
- UPS systems
- All other equipment required by IECo

3.3.9 Connection 161kV Switchyard and 161 kV Transmission line

The connection to the existing transmission line is in the scope of IECo.

3.3.10 Surrounding fence for the SWY + main control building + portal area, guard house, electrical gate, access road and car parking area

The whole SWY area has to be surrounded with a fence and equipped with an electrical gate. The following buildings have to be constructed and equipped with all necessary devices (electrical installations, grounding, lightning, control systems, HVAC, water supply, dewater system, etc.):

- Guard house
- Control building at the entrance of the site
- SWY operation building inside the premises of the substation, including all primary equipment for the part of the switchyard which is under the operational responsibility of the IEC
- Furniture, warehouse and indoor facilities (Tables, Chairs cupboards, etc.)

A car parking for minimum 8 vehicles has to be provided inside the SWY area.

Note:

The fence surrounding the SWY needs to be coordinated with IECo.

The SWY operation building is shared by IECo and the Owner. The installed equipment needs to be coordinated by both parties.

3.4 RESPONSIBILITY FOR INFORMATION

3.4.1 Data to be provided by the Contractor

- Detailed topographic survey; and
- Geological drillings and soil tests at lower reservoir area, portal / switchyard / DS soil tunnel area, upper reservoir area, waterways, soil resistivity measurements for the overall grounding system design, etc.
- Overall detailed execution design and engineering including without limitation:
    - Design reports
    - General drawings
    - Formwork and Reinforcement drawings
    - Steelwork drawings
    - Etc.
- Coordination and providing technical reports for authorities approval
- As-built documentation and operation and maintenance manuals
- All other data and documents required by the General and Particular Technical Specification
- O&M manuals, progress reports, etc.

3.4.2 Data to be provided by the Owner

	OWNER'S PROJECT DATA
Ref.	**Name/Title**
1	Geological input data, map, laboratory tests and in-situ soil investigations
2	Geotechnical Baseline Reports (GBR)
3	Topographic survey
4	Seismic study and NIP 41/a documents
5	Basic design documents – reports and drawings (Oct. – Dec. 2020) and an informative BoQ
6	Climatic data, air and water temperatures and water quality data (prepared by Mekorot)
7	IEA Criteria - appendix 6 of the Provisional License + Bonus and Fines table
8	IECo conditions for connecting new production units dated May 2015
9	Power Purchase Agreement, including all appendices thereto
10	Site Agreements
11	Water Supply Agreement, February 2015
12	Building Permit

Table 3-1: Owners project data

The Owner shall provide the EPC Contractor with the information and documents listed above.

It is clarified that the provisions of this section 2 (scope of work) do not derogate from the Contractor's liability with respect to the works, in accordance with the provisions of the Agreement including the design of the power plant, and the Contractor hereby waives any right, claim and/or remedy with respect to the information which will be provided by the Owner. For the avoidance of doubt, it is clarified that the Owner makes no warranties or representations with respect to any information provided by him. The Contractor is required to make independent inspection and examination of any relevant information, and assess any such information as an expert, all as provided in the Agreement.

3.4.3 Information to be submitted to the Owner for non-objection

It is clarified, that the provisions of the Agreement with respect to approval/non objection process shall govern any approval/non objection process pursuant to this Owner's Requirements.

4 GENERAL REQUIREMENTS

4.1 CODES AND STANDARDS

4.1.1 General

4.1.1.1 Design Framework

The Contractor shall design, execute and complete the works in accordance with good industry standards for hydropower projects similar to the works.

The design of the works, as documented in the design documents and elsewhere, shall:

- comply with applicable law, Israeli and international standards; and
- achieve all Owner's Requirements;

4.1.1.2 Required Standard of the Works

The Contractor shall use designs, methods, technologies and techniques that are reliable, well proven, safe, in accordance with current hydropower industry practice and state of the art. The works shall provide appropriate redundancy of critical components and shall avoid unproven arrangements. Untried materials, products and processes, or any other solution with limited operational experience, are specifically prohibited unless the Owner confirms, at its exclusive discretion, that appropriate assurances have been provided in writing and clear advantage to the Owner has been demonstrated.

On the basis that the works will be operated and maintained by the Owner in accordance with prudent utility practices and the Contractor’s operation and maintenance manuals, the civil works shall be durable with structures and equipment procured and constructed to perform their intended functions for the following periods:

Structure / Element	Life Duration
Reservoirs: dams, embankments, slopes	40 years
Water intakes and associated structures	100 years
All other civil works structures, including underground waterways and switchyard	50 years
Water tight membrane and associated layers (protection, drainage layer)	40 years
Expansion joints	50 years
Unit equipment (pump-turbine, motor-generator)	40 years
Power Transformers	50 years
HV cables	50 years
SFC & Switchgear (Medium Voltage and High Voltage)	25 years
SCADA system & protection	25 years

Table 4-1: Life duration of structures and Elements

The Contractor shall prove to the Owner that life duration of the equipment as above is achievable and maintained by document from the producers, from other projects, etc.

For the avoidance of doubt, for the purpose of these Owner's requirements, life duration is defined as the period of time during which the component can remain into service even though major maintenance or partial refurbishment is required.

Notwithstanding the foregoing, no major overhaul is expected before twenty (20) years after hand-over for main equipment (i.e. those with a life duration of more than 25 years) and civil works.

4.1.2 Definition of applicable standards

The works shall be designed, manufactured, constructed, commissioned, tested and completed in compliance with all applicable Israeli standards in accordance with the applicable law.

For each feature of the works, all civil works shall be designed and provided from the same suite of relevant applicable standards for civil works. Similarly, all plant, equipment and systems provided for each feature of the works shall be designed and provided from the same respective suite of relevant applicable standards for mechanical and electrical works. In addition, every reasonable endeavour shall be made to achieve standardization of civil works, plant, equipment and systems throughout the works through the use of common respective suites of the relevant applicable standards wherever possible.

Applicable standards are those standards, codes of practice, guidelines and references published by the institutions listed in chapter 4.1, as are pertinent, consistent and appropriate to the design and/or construction of a particular element of the works.

The design of civil works and other works shall be done according to Israeli Standards (I.S.), and the design has to be approved and authorized by an Israeli authorized and licensed structural engineer.

4.1.3 Adoption of other standards

Where applicable standards are silent, or do not fully or satisfactorily address an issue, or have a national or regional application inappropriate in the context of the design and/or construction of a particular element of the works, the Contractor may, subject to the Owner's non-objection, adopt other standards, such non-objection being at the Owner's absolute discretion. In considering the Contractor's proposals, the Owner will have regard to the implications of such standards on the functionality, availability and quality of the power plant.

If the Contractor seeks to adopt standards which are not applicable standards, it shall submit a written proposal for the Owner's consideration, nominating the standards on which it seeks to rely and giving reasons for the preference for such other standards. The proposal shall include copies of such other standards. If written in a language other than English, English translations of such documents shall be provided by organizations nominated by the Contractor for the Owner’s prior non objection. Any non-objection provided by the Owner to the use of such other standards, will not in any way release the Contractor from any of its responsibilities and liabilities nor shall it imply any responsibility on the Owner and shall not in any way diminish the Contractor's obligation to design, execute, complete and remedy any defects in the Works in accordance with the Agreement.

It is further clarified that in any event of Owner's reservations and/or comments, it shall be the sole responsibility of the Contractor to recheck and confirm any such comment.

4.1.4 Institutes providing applicable standards

Codes or standards proposed by the Contractor, either as alternates to those specified in the Owner’s requirements, or as codes or standards to be applied where none are specified in the specifications, shall be issued by one of the following organizations:

1 The Standards Institution of Israel (SII):
- Israeli Electrical Code
- Israeli Electrical Company (IEC) norms and requirement regarding medium, high and super-high voltage
- Israeli Inter-ministerial Standardization Committee specifications including:
  - chapter 08 (Electrical Installations)
  - chapter 18 (Communication Infrastructure)
  - chapter 34 (Fire detection and fire extinguishing systems)
  - chapter 54 (tunnelling)
- IS 5567 - Safety and Tunnelling Works
- IS 5620 - Geotechnical mapping of tunnel during construction

- IS 5826 - Design and Construction of Tunnelling Works (11 parts)
- IS 118 - Sampling and testing of fresh concrete

2 American Association of State Highway Transport Officials (AASHTO)
3 Air Moving & Conditioning Association (AMCA)
4 American Concrete Institute (ACI).
5 American Institute of Steel Construction (AISC)
6 American National Standards Institute, (ANSI)
7 American Society for Testing and Materials (ASTM)
8 American Society of Civil Engineers (ASCE)
9 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
10 American Society of Mechanical Engineers (ASME)
11 American Welding Society (AWS)
12 Association of Engineering Geologists.
13 BAEL 91 and its additions
14 British Standards Institutes (BSI)
15 Bureau Securitas (Securitas Institution)
16 Centre Scientifique et Technique du Bâtiment (CSTB)
17 CIGRE
18 Clouterre 1991
19 CM66 revised 82
20 Coordination Group for Technical Text (French Inter Ministerial Committee): Unified Technical Documents
21 Deutsches Institut für Normung (DIN)
22 Earthquake Rules 1992 (PS 92 Standard NFP 06 6013) and appendices together with AFPS 90
23 Energy Power Research Institute (EPRI)
24 European Committees for Standardisation (EN).
25 Eurovent Standards
26 French Association for Tunnelling (AFTES)
27 Institute of Electrical and Electronic Engineers (IEEE)
28 Institution of Mining and Metallurgy, London.
29 International Commission on Large Dams (ICOLD)
30 International Electro-Technical Commission (IEC)
31 International Society for Rock Mechanics (ISRM).
32 International Standards Organisation (ISO).
33 International Tunnelling Association (ITA)
34 Japanese Industrial Standards (JIS).
35 Laboratoire Central de Ponts et Chaussées (SETRA-LCPC)
36 Le Comité Consultatif International Téléphonique et Télégraphique (CCITT)
37 Le Comité Européen de la Chaudronnerie et de la Tôlerie (CECT)
38 Le Comité Européen de Normalisation Electrotechnique (CENELEC)
39 Les Normes Françaises (NF)
40 National Electrical Manufacturer's Association (NEMA)
41 National Electrical Safety Code, National Bureau of Standards (NESC)
42 National Fire Protection Association (NFPA)
43 National Fire Protection Association, National Electric Code (NEC)
44 Norwegian Geotechnical Institute (NGI).
45 Service d'Etudes Techniques des Routes et Autoroutes (SETRA) and Centre d'Etude Technique de l'Equipment (CETE)

46 SETRA-LCPC-TEXSOL
47 Sheet Metal and Air Conditioning Contractors' National Association, Inc. of America (SMACNA)
48 UK Chartered Institution of Building Services Engineers (CIBSE)
49 Uniform Building Code (UBC)
50 United States Army Corps of Engineers (COE)
51 United States Bureau of Reclamation (USBR)
52 Verein Deutscher Elektrotechniker (VDE)
53 Verein Deutscher Ingenieure (VDI)

All other institutes providing standards that are not listed above, have to be requested by the owner for non-objection.

4.1.5 Replacement by equivalent code or standard

If the Contractor wishes to supply materials or equipment which conform to standards other than those stipulated in the Owner's Requirements, it shall submit a written request. Any request for a change of code or standard during the execution of the Agreement shall be handled as a request for a change order.

A request for a change of code or standard shall include a copy of the proposed standard in English language and full details demonstrating that the equipment supplied under the proposed code or standard is equal or better and remains in full compliance with the specifications.

Unless the alternative standard is approved, the specified standards shall be applied. Any approval granted by the Owner shall not impose on the Owner any responsibility.

4.1.6 Homogeneity of codes and standards

A single standard shall be used for any one given item or component and the same standard shall be used for identical items or components throughout the scope of supply. Wherever possible the same standard shall be applied to like items or components. Any request by the Contractor for an exception to this general rule shall be handled as a request for a different standard.

Where recognized codes or standards do not exist, the Contractor shall apply prudent and generally accepted practices in the hydroelectric and utility industries. However, the Contractor shall also incorporate into the plant, any changes to such practices which are required from feedback from the operation and maintenance of similar plants or facilities. Any approval granted by the Owner shall not impose on the Owner any responsibility.

4.2 SYSTEM OF UNITS

The international metric system (SI) shall be used throughout for all calculation report, drawings, measurements and symbols.

All text including standards and codes supplied by the Contractor, including those supplied to the Contractor by third parties and based on a non SI system of units shall be completed by indications in the SI system of units. The latter shall govern the interpretation of such documents.

4.3 SAFETY PLAN

4.3.1 Security Requirements for the Plant

The Ministry of National Infrastructure, Energy and Water Resources (the "Ministry") has declared the Plant as "a critical infrastructure facility of Type A". As such, the security systems (both physical and cyber security) of the Plant (including their design and operation) are to be supervised by the Ministry, and must fully comply at all times with the regulation released periodically by the Ministry regarding the Plant's security requirements.

The Owner shall furnish the EPC with a draft Security Master Plan for the Plant (which shall be issued as an addendum to the RFP), which shall contain guidelines for the design of the physical and cyber security systems of the Plant.

The EPC is instructed to take the draft of the Security Master Plan into consideration in the preparation of their respective Proposals.

The EPC Contractor shall hire a security consultant for the design of the required security systems in accordance with the Security Master Plan provided by the Owner, and with any other applicable regulation. The security systems shall fully comply with all regulations issued by the Ministry and any other relevant Authority from the Taking Over Date and during the entire Operation Period.

4.3.2 Definition

The EPC Contractor shall have to implement, during the design and construction, a safety plan, whose objectives are the following:

- To establish a process for identification, documentation and control of project hazards.
- To classify hazards according to criticality for appropriate management action.
- To eliminate catastrophic and critical hazards.
- To provide the criteria for design reviews of safety issues.
- To ensure that the fire protection design are approved by local authorities.

The Contractor shall, as the Owner considers necessary, translate into Hebrew language parts of the final version of the Contractor’s safety plan. Such translations shall be made available to the Owner for information.

The Contractor shall report on the implementation, monitoring and performance of the safety plan in each progress report.

The Contractor shall regard the Israeli regulations and standards while implementing its Safety Plan, and the Safety Plan shall comply with all such regulations and standards.

The Contractor shall employ a Safety Officer (until handover to the O&M) and besides the Owner shall audit the Safety Plan and shall comply with any applicable Law.

4.3.3 PSPP safety goals

The design shall ensure the safety of the staff and the general public. The scope of the safety plan shall encompass the engineering, fabrication, supply, storage, construction, installation, test and commissioning of the PSPP system. Human safety shall always be given priority in a possible conflict with equipment safety.

As examples:

- warning systems shall provide early indications of failures which could produce hazardous conditions.
- fire prevention shall be designed followed by detection and extinguishing of fires, minimizing material losses as well as protection from injury in case of smoke emission.

4.3.4 PSPP safety principles

Definition:

- Fail-safe means that any component failure shall not result in a condition known to be unsafe.
- Checked redundant means that the probability of any combination of failures is low enough to provide a level of safety at least comparable to that provided by a fail-safe design.
- Note the Israeli Standards for Risk Management (SI 31000 and others)

Principles:

- During the detailed design, a risk register (see hazards categories below), including identified potential failures, shall be issued.
- Criticality analyses shall be performed for major components and elements of the total Project including failure modes, consequences and remedial solutions proposed.
- Safety critical components shall be fail-safe or checked redundant.

Categories of Hazard

- Category I - Catastrophic: Death or loss of PSPP system.
- Category II - Critical: Severe injury/occupational illness or major PSPP system damage.

- Category III - Marginal: Minor injury/occupational illness/PSPP system damage.
- Category IV - Negligible: Less than Minor injury/occupational illness/PSPP system damage.

4.4 PROSCRIBED MATERIALS

Designs and construction methods based on the following materials will not be permitted:

- High alumina cement in structural members;
- Wood wool slabs in lost formwork;
- Calcium chloride admixtures for use in reinforced concrete;
- Asbestos products and other materials generally known in the construction industry at the time of use to be carcinogenic;
- Aggregates for use in reinforced concrete susceptible to alkali aggregate reaction; have to comply with SII for aggregates for R.C.
- Grey cast iron
- Any other material generally known in the construction industry at the time of use to be deleterious or hazardous if used or incorporated in the works.

4.5 ENVIRONMENTAL AND SOCIAL REQUIREMENTS

4.5.1 Instructions for the construction phase

Instructions related to the subjects of landscape and ecological rehabilitation, appearance and antiquities sites are listed in the following chapters:

4.5.1.1 General guidelines for the construction phase

Prior to the entrance of equipment into the site or the execution of any activity in the site, the following shall be marked in accordance with the building permit:

- Boundaries of the work strip, including upper reservoir area, lower reservoir area and switchyard area.
- Mobilization areas.
- Limits of work lines for the upgraded access ways and temporary access roads.
- Underground existing facilities (Water lines, drainage lines, Electrical and communication ducts and cables, etc.)

Preparation of the area:

- Seeds shall be collected for direct seeding during rehabilitation works. Selection of vegetation and collection of seeds shall be performed by a specialist Contractor in this field in coordination with an ecologist. In order to avoid conditioning the start of work on the collection of seeds, the seed collection can be performed both in the site and subject to all authorizations and coordination which may be necessary, in adjacent areas around it.
- It is recommended that use be made of plants that will be transplanted for landscape rehabilitation and gardening from around the reservoirs at the edges of the project.
- Stripping of vegetation from areas and farmlands.
- Soil preserved for the rehabilitation stage shall be safeguarded in piles marked according to the landscape unit from which it has been taken. The marking shall be made clearly and shall be safeguarded until the soil is reused for coverage.

Execution of the work:

- Work and the movement of equipment or materials in natural areas will not be permitted outside of the areas approved for work and marked in the field and/or outside of the access ways. Access ways shall be located on existing routes.
- New temporary roads shall be made in accordance to the building permit
- If a temporary concrete plant will be erected in the switchyard or mobilization area, contaminated water produced from it shall be drained and discharged to a site approved according to the local law, or will be treated and recycled.

4.5.1.2 Guidelines for landscape and ecological rehabilitation

4.5.1.2.1 Guidelines for landscape rehabilitation

The guidelines in this subsection reference the minimization of expected damage and the landscape rehabilitation of the switchyard, the temporary cut & cover area section of the MAT portal and reservoir areas.

1) Minimization of damage during the work – the steps and measures that shall be taken in order to minimize impact shall be, inter alia, as follows:

   - Definition of the work site – in the framework of the detailed design, work sites, mobilization areas, temporary and permanent access ways, temporary mobilization and storage sites shall be defined; furthermore, locations of entry and exit of work equipment to and from the work areas shall be defined. No deviation will be permitted from these defined areas during execution of the work.

   - Definition of areas to be preserved – prior to commencing with the work, all landscape areas and elements designated for preservation (including individual trees) shall be identified and marked. The definition of these elements and areas, to the extent that they will be identified, will be made during field inspections with the participation of the supervisor of the National Infrastructure Committee and representatives of the National Park Authority. Items with special value located within the work area shall be relocated, the extent possible, within the project areas.

   - Stripping – prior to commencing with earthworks, the topsoil shall be scarified in order to preserve the soil for purposes of landscape rehabilitation. The scarified material shall be stockpiled and safeguarded for purposes of landscape rehabilitation while meticulously distinguishing between materials from various locations and areas.

2) Rehabilitation – the steps and measures that shall be taken in order to rehabilitate impacts created during the work shall be, inter alia, as follows:

   - Topography – the embankment of the lower reservoir shall be designed with moderate slopes in order to enable optimal landscape rehabilitation.

   - Use of scarified soil – during the landscape rehabilitation phase, the scarified soil shall be spread within those same areas from which the scarification was performed or, alternatively, other areas in accordance with the instructions of an agronomist or landscape architect.

   - Vegetation – as a rule, the intention is to preserve the character of the existing vegetation. In the framework of rehabilitating the vegetation, vegetation having an "agricultural" character shall be combined with Mediterranean Basin woody vegetation. These shall be placed in locations compatible with the landscape units bordering the plan area.

   - Agricultural use – agricultural uses shall be continued to the extent possible in adjacent farmed areas.

   - Indicators of the successful rehabilitation of vegetation – indicators for checking the success of the rehabilitation activities shall be defined in the framework of the permit application.

- The avocado plantation surrounding the Switchyard area should be re-planted in coordination with the Owner

3) Supervision – supervision has great influence on obtaining a quality product and minimizing environmental impact.

- On-site supervision – shall be performed by a supervisor having proven training and experience in the field of supervising the execution of landscape and vegetation works on infrastructure projects.

- Agronomic consultation – the construction process shall be accompanied by an agronomist who will provide instructions on issues of soil classification for landscape rehabilitation, types of vegetation for landscape rehabilitation purposes, the manner of executing the rehabilitation works and other matters.

- General supervision – the landscape architect shall be summoned for general supervision inspections at points of time and stages of construction as will be defined by him/her in advance, and will be coordinated with the on-site landscape supervisor.

- Electrical transmission lines - the instructions in this subsection refer to the minimization of anticipated damage and landscape rehabilitation along electrical power transmission lines.

- Local ground water, springs and water flow inside the underground works will be supervised by a hydro-geologist and NPA, under the responsibility of the Owner.

4.5.1.2.2 Guidelines for ecological rehabilitation

- In order to avoid impacting natural assets within spring areas, construction works near the spring shall be performed under the supervision of the Israel Nature & National Parks Protection Authority, coordination and payment under the responsibility of the Owner.
- Landscape rehabilitation shall be performed using topsoil that shall be safeguarded in separate stockpiles during preparation of the area for work as described in the provisions of the statutory plans.
- At the building application phase, guidelines for construction and landscape rehabilitation will be issued with reference to the preservation of topsoil and the mix of vegetation used in the rehabilitation works, if work will take place in natural (non-agricultural) areas.
- Landscape rehabilitation shall be performed using local vegetation. Embankments of the reservoir shall be stabilized with the use of low bushes and leafy plants only – not by planting trees – subject to engineering limitations.

4.5.1.2.3 Work within antiquities areas

- Any work shall be performed in accordance with the Antiquities Law 5738-1978 (hereinafter: "the Antiquities Law") and, to the extent required under the Antiquities Law, in coordination and supervision of the Antiquities Authority.
- A condition for issuance of a building permit shall be coordination with the Antiquities Authority and a decision as to whether preliminary inspections must be performed in the proposed alignment.

4.5.2 Instructions for reducing noise during the construction works

- Authorizations shall be demanded from those performing the works regarding the compliance of the various operating equipment with the provisions of and in accordance with the Israeli Regulations for the Prevention of Impacts (Noise from Construction Equipment) 5739-1979.
- Prior to commencing the works and during the works, the Contractor shall assure that noise levels from equipment and works are in accordance with the requirements of the said regulations.
- If blasting will be performed at the site, such blasting shall be performed in accordance with the Israeli regulations for the prevention of impacts (Unreasonable Noise) 5750-1990.
- All development and construction activities for the power plant shall comply with requirements of applicable Israeli law and regulations including for the prevention of impacts (Unreasonable Noise) 5750-1990.

4.5.3 Instructions for reducing dust impacts during the construction works

- Access ways to the site shall be planned in such a way as to avoid creating traffic jams and high air pollution levels as a result.
- At the construction phase, use shall be made of means to prevent dust from earthworks such as spraying water at points where work is being performed, covering trucks during travel and stabilizing dirt roads with the use of polymers or continual wetting in order to prevent dust forming from the movement of trucks wheels.

4.5.4 Instructions in the matter of safeguarding surface and groundwater sources

- Suitable technological means shall be employed at the site to prevent impacts on groundwater and surface water quality during design, construction and operation.
- Water tanks, piping systems and connections between them shall be provided using sealants and in a manner that does not allow seepage.
- Industrial wastewater, if produced, as a result of rinsing and maintenance of turbines or reservoirs and from various drains shall be discharged into a separate and sealed drainage systems and shall be handled on-site and/or taken from there to a disposal site approved by the Ministry of Environmental Protection.
- Groundwater that seeps into tunnels during excavation shall be pumped and discharged into adjacent reservoirs or into adjacent fish ponds, depending on water quality and Water Authority instructions.

4.5.5 Instructions in the matter of drainage

- The design shall be coordinated with the regional drainage authority.

4.5.6 Instructions in the matter of seismic activity and structural foundations

- The work shall be performed in accordance with: (a) relevant Israeli standards; (b) foreign standards in the absence of relevant Israeli standards; and (c) based on up-to-date professional literature and accepted global practices in the absence of standards while considering the geological structure of the site and surrounding areas.

4.6 INSTRUCTIONS FOR OPERATION OF THE POWER PLANT AND PHASING

4.6.1 Site operation

- Operation of the site shall be conditioned on obtaining confirmation from the engineer of the Local Planning & Building Committee, that the systems on site have been constructed in accordance with the approved specifications and that landscape rehabilitation of public open spaces, private open spaces and the reservoirs has begun.

4.6.2 Monitoring program

- A water monitoring program during the operation of the power plant shall be coordinated between the Owner and relevant authorities (the Ministry of Environmental Protection and the water authority).

4.6.3 Phasing

- The project shall be executed as a single unit with all of its components and parts in the stages and processes as described in principle in Section- 3.4 of the Environmental Impact Study.

4.7 INTRODUCTIONS FOR THE ROUTINE OPERATION PERIOD

4.7.1 Instructions in the matter of preventing soil and groundwater pollution

- All storage facilities for oil and fuels shall be installed within a sealed containment basin and shall be disposed of at sites licensed according to the Law.
- Auxiliary facilities that will be installed on the fuel storage infrastructure, if any, must be sealed (to prevent seepage of contaminants into the subsoil).
- Periodic monitoring of leaks from the tanks shall be performed.

4.7.2 Instructions for reservoirs as a focus of attraction for birds

- Fish shall not be placed in the reservoirs.

4.7.3 Instructions for high-voltage power lines with respect to electrocution of birds

- The issue of the need for protecting the electrical lines will be studied at the building permit phase and shall be coordinated with the Israel Nature & National Parks Protection Authority.

4.7.4 Instructions in the matter of safety

- The site, reservoirs and switchyard area shall be fenced, warning signs in the three official languages and all steps necessary shall be taken for the safety of people and animals in accordance with standards and the requirements of competent authorities.
- The tunneling work shall be designed in accordance with Israel Standard 5567, which deals with "instructions and guidelines for work safety in tunneling works in the construction industry."
- Firefighting means taken during construction shall comply with the requirements of Israel Standard 5567 and the fire protection authority.

5 DESIGN REQUIREMENTS

5.1 DESIGN REQUIREMENT FOR CIVIL WORKS

5.1.1 Seismic force design

The following basic design parameters shall be adopted in the design of the works:

Type of Earthquake	PGA	Effective Acceleration		Probability	Return Period
		horizontal	vertical		
OBE	0.24 g	0.160 g	0.048 g	10%	475 years
MCE	0.43 g	0.287 g	0.086 g	2%	2475 years

Table 5-1: PGA Seismic loads for upper reservoir area

Type of Earthquake	PGA	Effective Acceleration		Probability	Return Period
		horizontal	vertical		
OBE	0.25 g	0.167 g	0.050 g	10%	475 years
MCE	0.45 g	0.300 g	0.090 g	2%	2475 years

Table 5-2: PGA Seismic loads for lower reservoir area

Horizontal acceleration for pseudo static analysis shall be not less than 2/3 peak ground acceleration defined above. Vertical acceleration for pseudo static analysis shall be not less than 20% of the peak horizontal ground acceleration defined above. Accelerations shall be applied simultaneously.

Methods based upon permanent displacements shall be allowed, as per requirements detailed in 5.1.5 and 5.1.14.

5.1.2 Wind force design

The following basic wind design parameters shall be adopted in the design of all structures including: Wind pressure for structural design, freeboard design and the design of the fixation system of the reservoir sealing / lining including uplift forces.

In the table below, the wind velocities to be used for PSPP Manara project are shown.

Reservoir	Manara
Upper	33m/s
Lower	27m/s

Table 5-3: Wind velocities

The design of the 161 kV switchyard equipment must comply with a maximum wind velocity of 40m/s.

5.1.3 Reservoir capacity and water for first filling procedure

Minimum active capacity: 1.16 mio m^3 between Full Supply Level (FSL) and Minimum Operating Level (MOL). The useful minimal capacity should enable a minimal continuous production period of 8 hours in full load.

Water source for the first filling and the annual compensation will be according to "The Water Supply Agreements" between Owner, and local water association, all in accordance with the EPC Contract.

There are environmental issues concerning ground water level and the according elevation of the water in the springs by the authority. Therefore the first filling procedure of the reservoirs will need coordination and approval by the Israeli Water Authority. Without derogating from any of the Contractor's responsibilities and liabilities, the communication with the authority is done by the Owner.

Conveying of the water from the source to the lower reservoir will be through a steel pipe with an outside and inside anti-corrosion protection.

The Contractor shall elaborate a fill procedure including a safety and monitoring concept in coordination with the Owner and the Owner's Engineer.

Notwithstanding the above, meanwhile, the proposed filling procedure can be given as follows:

1. Filling of lower reservoir with water from the water source. (Active volume 1.26 mio. m^3 (including ~5% compensation for evaporation) + dead storage volume 0.19 mio. m^3)
2. Filling of low pressure tunnel via gravity
3. Filling of high pressure tunnel part via gravity
4. Filling of high pressure shaft with a temporary pump situated in the cavern, or with water source at upper reservoir (~0.01 mio. m^3).
5. Before start commissioning of the pump turbine the upper reservoir will be filled up to 95% of the active storage volume, this represents a volume of approximately 1,100,000 m^3. During detailed commissioning planning the water consumption will be analyzed and optimized with the goal to significantly reduce the necessary water volume for commissioning.

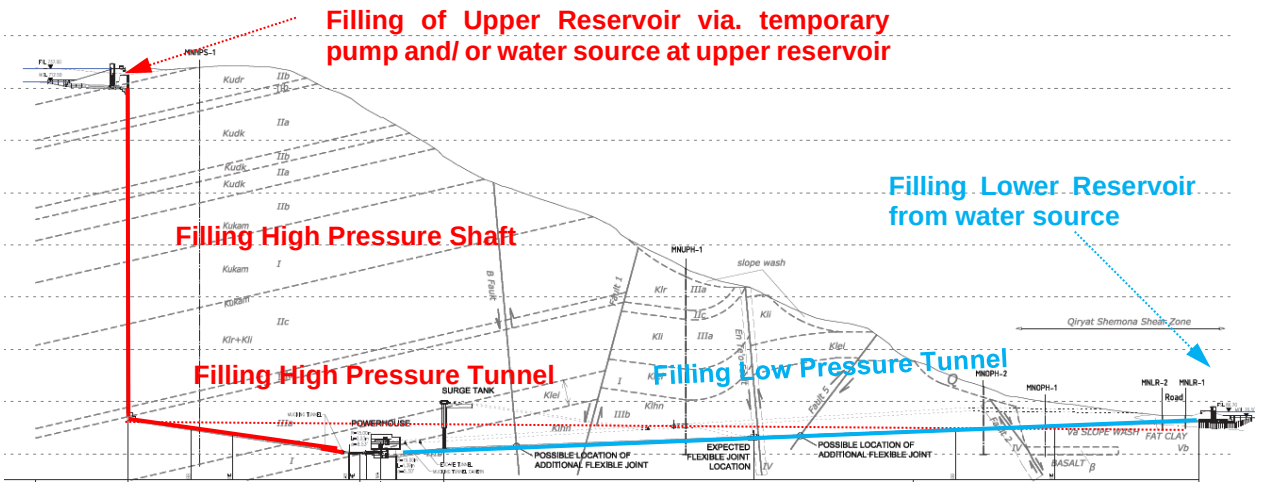


Figure 5-1: Filling procedure of reservoirs

5.1.4 Emergency Contingency Plans

The Contractor shall prepare Emergency Contingency Plans relating to the safety and security of persons and the environment arising from or consequent upon impounding of:

- the upper reservoir (including filling the hydraulic circuits) and
- the lower reservoir (including filling the hydraulic circuits).

The Emergency Contingency Plans shall outline responsibilities of the EPC Contractor, especially in case of identification and notification of population at risk.

The Emergency Contingency Plans shall include the following requirements for each of the elements of the Works:

- emergency identification and evaluation;
- preventative actions if available;
- notification procedures and flow charts;
- communication system;
- response during periods of darkness and adverse weather;
- sources of equipment;
- stockpiling of supplies and equipment;
- emergency power supplies;
- inundation maps with predicted water levels;
- indicative filling program.

The Emergency Contingency Plans shall propose procedures suitable for each element of the Works considering physical characteristics and consequential risks.

The Contractor shall submit the final Emergency Contingency Plans to the Owner for non-objection no later than 90 days prior to commencement of impounding the reservoirs.

5.1.5 Upper reservoir design

First filling:

The Contractor shall have flexibility in determining the times of filling of the upper reservoir, by utilizing the water allocation and the water supply Agreements, which will be made available to the Contractor for such purpose, in accordance with the provisions of the Agreement. Any filling shall be prohibited as long as:

- the reservoir bottom outlet valve is not installed, fully tested and commissioned,
- the intake gate and the stoplogs are not installed, fully tested and commissioned
- There is “non-objection” for the filling plan (procedure) by the Owner

During the impounding, provision shall be made for at least 2 interim steps prior to reaching FSL, each of them lasting 4 days during which a complete monitoring of the slopes and the Fill dam and appurtenant structures shall be carefully made. The elevation of each of the 2 interim steps shall be specified during the detailed design studies.

Embankment Stability criteria:

Prior the calculation, the subsoil parameters shall be verified preferably after excavation of the lower reservoir dam foundations and prior to start of fill dam construction.

LC1: FS ≥ 1.5 under steady state conditions with the Reservoir at Full Supply Level;

LC2: FS ≥ 1.5 during normal (daily) rapid draw down of the Reservoir for the following conditions:

- no inflow into the Reservoir and
- discharge into the Hydraulic circuit equal to the maximum turbine capacity making the reservoir elevation change from FSL to MOL ,
- no earthquake.
- no membrane tearing and associated leaks that could trap water pressures behind the membrane

LC3: FS ≥ 1.3 with reservoir empty at the end of the construction and no earthquake

LC4: FS >1.4 under steady state condition with reservoir at crest elevation

LC5: FS > 1.0 with Maximum Credible Earthquake (MCE), and reservoir at Full Supply Level

LC6: FS ≥ 1.2 with Operating Basis Earthquake (OBE), and reservoir at Full Supply Level

LC7: FS ≥ 1.1 in case of membrane tearing and daily drawdown for operation in 8 continuous hours between FSL and MOL in full load

Regarding the membrane tearing and associated leakage risk for LC7, the selected damage risk for the membrane shall be the following:

- Welding issue: 0.5 m long and 1 mm wide tear
- Mechanical hole: 5 mm wide or 0.2 cm^2

The leakage resulting from such damage shall be estimated by the EPC who, after analysing the embankment cross section and mainly the various materials permeability shall assess the pore pressure distribution inside the fill with such a drawdown velocity - reached when going from FSL down to MOL at full discharge.

Note: For MCE the factor of safety can be slightly below 1.0, but then consequently the calculated displacements have to be determined and evaluated in respect to safety- and serviceability requirements. No uncontrolled water leakage is allowed to take place.

Stability criteria alternative:

Should:

- the required factors of safety for the LC5 (MCE event) and LC6 (OBE event) load cases not be reached with the Pseudo Static Analysis, but LC6 factor of safety be greater than 1.1
- or the required factor of safety for the LC5 (MCE event) not be reached with the Pseudo Static Analysis, but the LC6 factor of safety be met
- and an acceptable design for the embankments be proposed by EPC (regarding the excavations done to reach the required net volume, the spoils balance, the land constraints)

then the following approaches shall be implemented:

A stability analysis shall be undertaken using a Pseudo Dynamic Analysis (PDA) approach.

The stability calculation shall be applied to all the representative cross sections of the embankments including (but not limited to) the highest ones. When selecting the cross sections, particular attention shall be paid to the geotechnical foundation parameters and the slope for both upstream and downstream shells of the dam. A minimum number of 5 cross sections shall be tested regarding stability.

In addition to the PDA, a calculation with Time History Analysis (THA) approach shall be conducted for LC5 and LC6 load cases (MCE and OBE events) as required, but limited to the most critical section.

The Time History Analysis calculations shall be performed with undrained soil conditions and a total stress approach. The calculation shall make use of the seismic records which serves as reference for the site response report issued by S. Frydman

and M. Talesnick (August 2010) , or an updated one that will be provided by the Owner.

Calculated displacements along a sliding surface shall not exceed the lesser of the following criteria:

- For OBE event:
  - 20 cm for both vertical and horizontal displacement
- For MCE event:
  - 3.0 % of the embankment total height for both horizontal and vertical displacement.
  - 60 cm for the horizontal displacement
  - Freeboard/3 (2) (one third of the freeboard) or 60 cm for the vertical displacement whichever is smaller.

Calculations regarding the expected settlements during construction and during operation have to be executed for at least 5 sections. The soil parameters have to be verified by means of plate baring tests for example.

Watertight liner stability criteria:

The minimum slope for placement shall comply with good design and engineering practice. Laboratory tests shall be performed in order to confirm membrane stability over the underlying layer in dry and wet conditions, such as EN ISO 12 957/2, 2004 or the shear box tool.

Moreover, the following Factors of safety shall be fulfilled:

- >1.5 regarding uplift with natural water table
- >2 regarding Wind effect
- >1.5 regarding Uplift with gas
- >1.5 regarding potential soil swelling effect
- >1.3 regarding loss of water tightness (due to extension) under water pressure

The liner drainage shall be compartmentalized in order to detect the location of leakages. A minimum of 9 compartments is required.

Reservoir Bottom Outlet valve:

In the extreme event when (i) a seismic event damages the membrane and puts the embankment at risk and (ii) the Powerhouse is out of order, it must be possible to lower the reservoir elevation by opening of the reservoir Bottom outlet valve. The criterion to be applied is to lower the reservoir elevation from FSL to an elevation where the total thrust on the upstream batter is halved in less than 8 days, with no inflow. The downstream restitution place shall be engineered (dissipation basin, rockfill protection) in order to avoid erosion of the natural ground.

The liner design:

Two options for the reservoir lining are permitted:

- Alternative 1 – PVC geo-membrane (white): The liner shall be associated with an underlying protecting non-woven geotextile min. 500 g/m² and an underlying drainage layer existing of gravel with a minimal thickness of 30 cm. The fixation system of the liner shall be well designed with anchor trenches, to withstand the uplift wind forces.
- Alternative 2 - Asphalt lining: The asphalt lining shall be associated with an underlying drainage layer existing of gravel with a minimal thickness of 30 cm.

See clause 5.7 – Alternatives to the Project.

Long term performance:

The liner chemical composition or design shall be consistent with the life duration specified in chapter 4.1.1.2, mainly regarding UV attack.

For geo-membrane liner type, at the end of the construction, the membrane shall be exempt from folds except in dedicated places where justification is provided by the Contractor (for settlement provision or any other technical reason).

The design will be such that the drainage system that shall monitor the leaks through the liner shall not be influenced by water coming from any rise of the ground water table up to a 50 years ARI event.

Settlement criteria:

Differential settlements between the embankment and concrete structures, and between different parts of the embankment (due to foundation materials or embankments materials) shall be consistent with a safe behaviour of the watertight membrane in all respects regarding folding, tearing, tension and other parameters as warranted by the liner manufacturer.

Monitoring:

Drainage discharge, piezometers inside the embankment, vertical extensometers for the embankments / foundation of the dam and concrete structures settlements and displacements shall be measured and monitored in order to check the safe behaviour of the structure.

Crest protection:

Whichever protection is selected for the membrane, particular devices shall be taken into account in order to avoid any overflow of the crest under wind wave action. In case of parapet wall, the structure shall be stable under wind wave action, according to the following criteria:

Load Case (including wind wave action)	Sliding FS	Overturning criteria Minimum base area in compression %	Minimum Bearing Capacity FS
Water level = FSL	1.5	100	3
Water level = Reservoir crest elevation	1.33	75	2
FSL + OBE	1.3	75	1.5
FSL + MCE	1	Resultant within base	>1

Design of the crest:

A super elevation (transversal slope) shall be managed in order to direct the run off towards the reservoir.

Optional floating cover:

There is a possibility that the Owner decides that a floating cover will be installed at the Lower Reservoir. Such decision, if and when relevant, shall constitute a Change Order in accordance with the provisions of the Agreement.

5.1.6 Upper water intake

Hydraulics:

The flow velocity through the trash racks, under steady-state conditions, shall not exceed 1.0 m/s on a net area basis.

Vortices type 1 or 2 are allowed according to EPRI/ASCE 1989 (incoherent surface swirl or surface dimple). There shall be no vortices of type 4, 5 and 6, and vortices of type 3 shall not occur other than intermittently.

Flow calibration by a CFD analysis and adequate software shall be undertaken prior to any structural analysis, in order to prove that the flow patterns are acceptable in both turbine and pumping modes:

- inside the concrete structure, and do not lead to abnormal gradients or head losses
- outside the concrete structure, showing an adequate feeding and no detrimental swirling effect with high velocity, that could disrupt the intake discharge capacity.

The CFD analysis to be verified by the Contractor.

Stability:

These criteria apply to any block situated between construction joints (equipped with water stops, but with no cross over rebars).

Stability against uplift: FS = 1.3 (calculated either at the end of the construction with anticipated water table elevation or during operation (including natural water table and critical water elevation inside the reservoir with stoplogs inside their slots).

Stability against sliding and overturning (uplift assessed according to ground permeability):

Load Case	Sliding	Overturning criteria Minimum base area in compression %		Minimum Bearing Capacity
	FS	Soil Foundation	Rock Foundation	FS
Water level = FSL	1.5	100	100	3
Water level = Reservoir crest elevation	1.33	75	75	2
FSL + OBE	1.3	75	75	1,5
FSL + MCE	1	Resultant within base	Resultant within base	>1
End of Construction	1.33	75	75	2

Note: Sliding safety factors are related to residual foundation values.

Settlements:

Settlements of the structure shall be consistent with a safe behaviour of the watertight membrane (asphalt, geo-membrane), which is laid upon the upstream face of the reservoir bottom and tied to the concrete structures (blocks) that are part of the intake.

Monitoring:

The structure shall be surveyed in 3 D (X,Y and Z).

5.1.7 High pressure water way

These criteria apply to the following section of works: HP vertical shaft, HP tunnel HP manifold and HP penstock.

The maximum permissible steady state water velocity shall be lower than 5 m/s for concrete lined conduits and lower than 8 m/s for steel lined conduits except specific items (e.g. part before MIV).

Concerning hydraulic losses, the hydraulic design of the power circuit has to be designed in such a way, so that the weighted cycle efficiency according to IEA criteria is fulfilled. Therefore see IEC acceptance test procedure.

The maximum permissible steady state water velocity shall be consistent with the circuit’s head losses, the hydraulic transients behaviour (and associated pressures) created by the equipment. Any change of the current design (to the extent implemented in accordance with the provisions of the Agreement) shall be documented regarding these issues.

Transient calculations of the power water way system, considering the specific pump turbine behaviour and the potential load cases as the following items have to be executed prior the structural design of the power water way lining:

- Pump-turbine shut down (pump mode (PM) and turbine mode (TM))

- Load rejection of pump turbine (PM and TM)
- Starting of pump turbine (PM and TM)
- Change of operation modes from PM → TM and TM → PM, in resonance of surge tank
- Gate operation in reflection time of high pressure circuit.

The high pressure waterways shall be steel lined throughout, and shall safely withstand extremes of internal and external pressure at all points.

The design of the steel liners shall be in accordance with the load cases, pressure transients and other provisions published by C.E.C.T (Recommendations for the design; manufacture and erection of steel penstocks of welded construction for hydroelectric installations) using the methodology given in American Society of Civil Engineers (ASCE) and Energy Power Research Institute (EPRI) Guides 1989 Volume II – "Civil Engineering Guidelines for Planning and Developing Hydro-electric Developments". In particular, when the steel liners are to be designed with the internal load shared between the steel and surrounding rock and concrete, then both conditions (e) and (f) of Table 1 in Appendix IID of the CECT Recommendations shall be satisfied.

For detailed requirements regarding corrosion protection, it will be referred to the technical specifications in Volume 4 of the tender.

The design of the steel liners shall also provide for a radial gap which shall be determined by the Contractor during the detailed design, but the gap shall not be less than $3 \times 10^{-4} \times R_i$. The Contractor shall be responsible for the decision on the value of the gap.

Particular care shall be taken with quenched and tempered high grade steels that may develop cold cracking and need pre-heating during welding process. The choice of such type of steel is subject to the SPC non objection.

At present no draining system along the final lining of the high and low pressure power waterway is foreseen. This is the preferred solution. For the steel lining the maximum pressure of the ground water for each section has to be considered and designed accordingly.

Alternatively the steel lined portion of the waterways may be supplied with a draining system in the high pressure waterway in order to reduce the external pressure and, consequently, the steel lining thickness. If such a methodology is selected by the Contractor, the following solution is suggested:

- Drainage in the high pressure waterway could be done through the pressure reducing valves installed in the existing contact grouting holes in the steel lining.
- The valves have a characteristic to open in case that external pressure is higher than the internal pressure in the power waterway.,
- along each 100 m of drained section, a piezometer shall be installed in order to record the external pressure and check that the design pressure is not reached,
- there are environmental issues concerning ground water level and the according elevation of the water in the springs by the authority. Therefore underground draining systems need coordination and approval by the Israeli Water Authority.

If the steel lining thickness design is governed by the internal pressure (with rock participation), in situ tests shall be performed in order to prove that the required rock modulus, taken into account in the design, is achieved.

The manifold shall be designed without taking the surrounding rock (condition “d” of the CECT) into account. It may be drained. If the manifold designer does not exhibit enough prototypes able to guarantee adequate head loss value, a hydraulic model test shall be performed.

Contact grouting between steel lining and surrounding concrete must be carried out on a systematic basis in order to fill the gap between steel lining and backfill concrete.

In the horizontal section of the high pressure power water way additionally the shrinkage gab at the crown between rockmass and backfill concrete must be filly by grout. Can be done either with grouting pipes or by systematic crown gap filling through radial drill holes (every 2-3 meters in crown area).

A HP tunnel and shaft filling test (TFT) shall be undertaken once the work is completed and the Main Inlet Valve (Spherical valve) is installed. Its purpose shall be to confirm that the HP circuit’s water tightness is acceptable.

During the HP TFT, the HP waterway (from intake down to the main inlet valve) shall be pressurized with 3 stages, (1) under upper reservoir MOL, (2) with the water at el. 300 and (3) with water at el. 71. Each pressure stage shall be maintained during 48 hours. The procedure shall include, but not limited to, the water elevation record on a permanent basis.

5.1.8 Underground powerhouse / cavern

5.1.8.1 Geology

The cavern is planned to be placed in the geological formation Klei (formation class I; lithology is limestone and dolomite) with enough overburden of sound rock, to ensure a stable cavern excavation and a low deformation level.

The current location of this formation is interpreted from two drillings (MNHPS-1 and MNUPH-1). The exact location of the I formation will be defined during the geological analysis of the access tunnel excavation. The position of the cavern has to be fixed (maybe adopted) in Agreement with the Owner and the Owners engineer to fit the actual geological conditions.

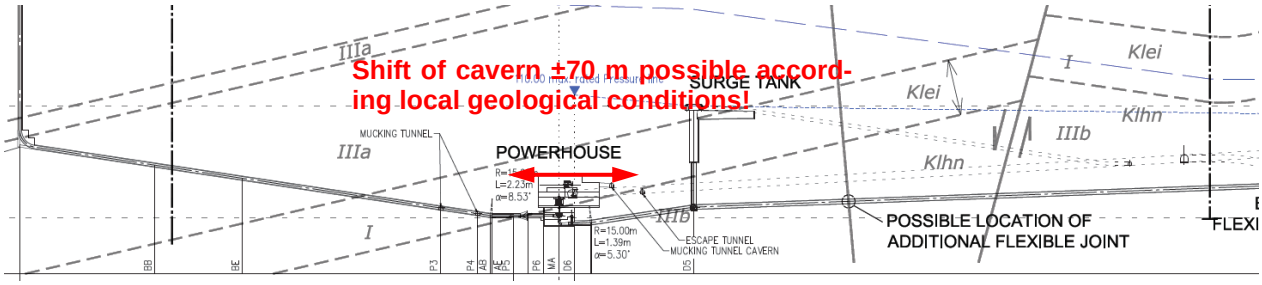


Figure 5-2: Location of cavern

Note: According the statement above, the location of the cavern and the according power water way system can shift ±70 m up/downstream compared with the current design.

5.1.8.2 Geotechnical analysis

The cavern layout and design shall be the subject of a FEM analysis, comprising:

- An approach with discontinuous material (using, as an example, the software “Unwedge 3D” or “UDEC”) depending on the fracturation density that will be observed at the excavation area. In a first estimate, according to current geological knowledge, continuous approach is pertinent enough to design underground support.
- An approach with continuous material, considering an elasto-plastic rock behaviour of cavern.

5.1.8.3 Rock surrounding of the cavern

An elasto-plastic constitutive law shall be taken into account to appraise the stability conditions of the rock surrounding the cavern. In order to appraise the excavations stability, the designer shall propose the to Owner's Engineer for non-objection a series of criteria (including, but not limited to the deformation) based upon the specific constitutive law used in the software.

5.1.8.4 Permanent Lining

The permanent lining of the PH crown can be made with shotcrete, lattice girder and wire mesh.

5.1.8.5 Wedges stability (Unwedge Load Cases)

If a rock wedges stability is required, the calculations have to fulfil the following requirements:

Place	Elevation	Seismic	FS
Main Cavern	Vertical wall above exciter level	No	1,5
		OBE	1,2
		MCE	1,1
	Crown	No	2,0
		OBE	1,4
		MCE	1,1

5.1.8.6 Structural analysis

Vibrations created by the units (normal behaviour or runaway speed) shall be taken into account for (i) stress propagation inside the surrounding concrete, (ii) vibration of the surrounding concrete and (iii) fatigue perspective (for this purpose, the designer shall select an adequate code, but the AASHTO Bridge Manual may serve as a guideline).

Furthermore a dynamic stiffness analysis for the concrete structure has to be executed by the EPC, to verify the requirements of the pump turbine and generator suppliers.

5.1.8.7 Monitoring

Monitoring devices shall be installed to monitor the crown behaviour in 3D (X,Y and Z). Three profiles comprising at least 5 monitoring points each shall be installed.

5.1.9 LP tunnel

These criteria apply to the following sections of works: Lower Intake, LP tunnel.

The maximum permissible steady state water velocity shall be lower than 5 m/s for concrete lined conduits and lower than 8 m/s for steel lined conduits except specific items.

The maximum permissible steady state water velocity shall be consistent with the circuit’s head losses and the according cycle efficiency, the transients (and associated pressures) created by the equipment. Any change of the current design (to the extent implemented in accordance with the provisions of the Agreement) shall be documented regarding these issues.

Concerning transient calculation it is referred to chapter 5.1.7.

The whole LP tunnel shall be concrete lined throughout, and shall safely withstand extremes of internal and external pressure at all points. The alternative steel lining is described in 5.7.2.

Grouting between the concrete and surrounding rock shall be performed all along the tunnel. The grouting shall be carried out on a systematic basis in order to fill in the gap.

A LP tunnel filling test (TFT) shall be undertaken from lower reservoir down to the LP gate, once the works completed and the LP gate installed. Its purpose shall be to confirm that the LP circuit's water tightness is acceptable. During the TFT, the LP tunnel shall be pressurized with 2 stages, (1) under lower reservoir FSL and (2) with half the previous pressure. Each pressure shall be maintained during 48 hours. The procedure shall include, but not limited to, the water elevation record on a permanent basis.

The design of the low pressure tunnel has to provide a water tight power tunnel system for the operation of the plant. Leakages have to be minimized. In areas where the concrete lining (pre-stressed section or reinforced section) cannot guarantee this issue (e.g. in the area where the tunnel is situated in the slope wash, and/or the ground water level is higher than the internal water pressure), an additional lining layer consisting of a PVC foil system has to be provided. The design shall (i) clearly compare the maximum static internal pressure and the natural minimum water table elevation in order to appraise the risk of leakage, (ii) take account of the permeability of the natural ground that surrounds the tunnel (permeability measured thanks to Lefranc tests at the tunnel location), (iii) consider the concrete tunnel as a water retaining structure (as per ACI) and (iv) equip each of the construction joints with an appropriate waterstop.

5.1.10 Surge tank

A surge tank has to be designed downstream of the powerhouse to restrict the maximal pressure in the low pressure tunnel during the regulation of the pump turbines and to improve the controllability of the pump turbines itself. In the current design a throttled surge tank with one horizontal chamber is planned, to fulfil this requirements as good as possible. During the required transient calculation, the surge tank design has to be verified and discussed with the Owner's Engineer.

To confirm the present throttle design (loss values) of the sure tank, a CFD analysis has to be executed by the EPC prior the final surge tank design for verification of the loss values.

5.1.11 Flexible joint element

If active faults are crossed by the LP tunnel, flexible joint elements shall be installed in order to absorb the deformation with time. The assumption regarding deformation of the ground is 1 mm/year in each direction (X, Y and Z). The equipment shall be designed to fulfil its intended function during the required design life duration specified in chapter 4.1.1.2. The Owner shall instruct the Contractor to install up to three (3) such flexible joint elements at dedicated places, selected during the geological analysis during the access and low pressure tunnel excavation.

Note: Present only one of the fault is suspected to be active and needs to be equipped with an flexible joint element.

5.1.12 LP transition slope wash / soil - rock

The LP tunnel crosses the geological interface between slope wash / soil and rock near at chainage ~1+700. During the detail design and following construction phase special attention has to be given to this intersection.

The following requirements have to be fulfilled:

- The design shall give provision for differential movements for the intersection of slope wash and rock.
- The design shall (i) clearly compare the maximum static internal pressure and the natural minimum water table elevation in order to appraise the risk of leakage, (ii) take account of the permeability of the natural ground that surrounds the tunnel (permeability measured thanks to Lefranc tests at the tunnel location), (iii) consider the concrete tunnel as a water retaining structure (as per ACI) and (iv) equip each of the construction joints with an appropriate waterstop.

5.1.13 Lower intake

Hydraulics:

The flow velocity through the trash racks, under steady-state conditions, shall not exceed 1.0 m/s on a net area basis.

Vortices type 1 or 2 are allowed according to EPRI/ASCE 1989 (incoherent surface swirl or surface dimple). There shall be no vortices of type 4, 5 and 6, and vortices of type 3 shall not occur other than intermittently.

Flow calibration by a CFD analysis and adequate software shall be undertaken prior to any structural analysis, in order to prove that the flow patterns are acceptable in both turbine and pumping modes:

- inside the concrete structure, and do not lead to abnormal gradients or head losses
- outside the concrete structure, showing an adequate feeding and no detrimental swirling effect with high velocity, that could disrupt the intake discharge capacity

The CFD analysis to be verified by the Contractor.

Stability:

This criterion applies to any block situated between construction joints (equipped with water bars, but with no cross over rebars).

Stability against flotation: Fs = 1.3 (calculated either at the end of the construction with anticipated water table elevation or during operation (including natural water

table and critical water elevation inside the reservoir with stoplogs inside their grooves)

Stability against sliding and overturning (uplift assessed according to ground permeability):

Load Case	Sliding	Overturning criteria Minimum base area in compression		Minimum Bearing Capacity
		Soil Foundation	Rock Foundation	
	FS	%	%	FS
Water level = FSL	1.5	100	100	
Water level = Reservoir crest elevation	1.33	75	75	2
FSL + OBE	1.3	75	75	1.5
FSL + MCE	1	Resultant within base	Resultant within base	>1
End of Construction	1.33	75	75	2

Settlement criteria:

Settlements of the structure shall be consistent with a safe behaviour of the watertight membrane (asphalt, geo-membrane), which is laid upon the upstream face of the reservoir bottom and tied to the concrete structures (blocks) that are part of the intake.

Monitoring:

The structure shall be surveyed in 3 D (X,Y and Z).

5.1.14 Lower reservoir design

First Filling:

The Contractor shall have flexibility in determining the times of filling of the lower reservoir, by utilizing the water allocation and the Water Supply Agreements, a copy of which will be made available to the Contractor for such purpose, in accordance with the provisions of the Agreement. Any filling shall be prohibited as long as:

- The reservoir bottom outlet valve is not installed, tested and commissioned, in order to release water if necessary (in case of dangerous behaviour that could put the embankment at risk);
- The intake gate and the stoplogs at the lower intake are not installed, fully tested and commissioned together with a temporary pumping system capable to ensure safe and suitable working conditions in the LP tunnel in case of leakage from the stoplogs or the gates;
- The draft tube gates in the PH are not fully installed, tested and commissioned, unless particular safety measures are taken in order to protect the workers and the works in the LP tunnel and the PH against flooding or leakage;
- There is “non-objection” for the filling plan (procedure) by the Owner

During the impounding, provision shall be made for at least 2 interim steps prior to reaching FSL, each of them lasting 4 days during which a complete monitoring of the embankments and appurtenant structures shall be carefully made. The elevation of each of the 2 interim steps shall be specified during the detailed design studies.

Embankment Stability criteria:

Prior the calculation, the subsoil parameters shall be verified preferably after excavation of the lower reservoir dam foundations and prior to start of fill dam construction.

LC1: FS ≥ 1.5 under steady state conditions with the Reservoir at Full Supply Level;

LC2: FS ≥ 1.5 during normal (daily) rapid draw down of the Reservoir for the following conditions:

- no inflow into the Reservoir and
- discharge into the Hydraulic circuit equal to the maximum turbine capacity making the reservoir elevation change from FSL to MOL ,
- no earthquake.
- no membrane tearing and associated leaks that could trap water pressures behind the membrane

LC3: FS ≥ 1.3 with reservoir empty at the end of the construction and no earthquake

LC4: FS >1.4 under steady state condition with reservoir at crest elevation

LC5: FS > 1.0 with Maximum Credible Earthquake (MCE), and reservoir at Full Supply Level

LC6: FS ≥ 1.2 with Operating Basis Earthquake (OBE), and reservoir at Full Supply Level

LC7: FS ≥ 1.1 in case of membrane tearing and daily drawdown for operation in 8 continuous hours between FSL and MOL in full load

Regarding the membrane tearing and associated leakage risk for LC7, the selected damage risk for the membrane shall be the following:

- Welding issue: 0.5 m long and 1 mm wide tear
- Mechanical hole: 5 mm wide or 0.2 cm^2

The leakage resulting from such damage shall be estimated by the EPC who, after analysing the embankment cross section and mainly the various materials permeability shall assess the pore pressure distribution inside the fill with such a drawdown velocity - reached when going from FSL down to MOL at full discharge.

Note: For MCE the factor of safety can be slightly below 1.0, but then consequently the calculated displacements have to be determined and evaluated in respect to safety- and serviceability requirements. No uncontrolled water leakage is allowed to take place.

Stability criteria alternative:

Should:

- the required factors of safety for the LC5 (MCE event) and LC6 (OBE event) load cases not be reached with the Pseudo Static Analysis, but LC6 factor of safety be greater than 1.1
- or the required factor of safety for the LC5 (MCE event) not be reached with the Pseudo Static Analysis, but the LC6 factor of safety be met
- and an acceptable design for the embankments be proposed by EPC (regarding the excavations done to reach the required net volume, the spoils balance, the land constraints)

then the following approaches shall be implemented:

A stability analysis shall be undertaken using a Pseudo Dynamic Analysis (PDA) approach.

The stability calculation shall be applied to all the representative cross sections of the embankments including (but not limited to) the highest ones. When selecting the cross sections, particular attention shall be paid to the geotechnical foundation parameters and the slope for both upstream and downstream shells of the dam. A minimum number of 5 cross sections shall be tested regarding stability.

In addition to the PDA, a calculation with Time History Analysis (THA) approach shall be conducted for LC5 and LC6 load cases (MCE and OBE events) as required, but limited to the most critical section.

The Time History Analysis calculations shall be performed with undrained soil conditions and a total stress approach. The calculation shall make use of the seismic records which serves as reference for the site response report issued by S. Frydman and M. Talesnick (August 2010) , or an updated one that will be provided by the Owner.

Calculated displacements along a sliding surface shall not exceed the lesser of the following criteria:

- For OBE event:
  - 20 cm for both vertical and horizontal displacement
- For MCE event:
  - 3.0 % of the embankment total height for both horizontal and vertical displacement.
  - 60 cm for the horizontal displacement
  - Freeboard/3 (2) (one third of the freeboard) or 60 cm for the vertical displacement whichever is smaller.

Calculations regarding the expected settlements during construction and during operation have to be executed for at least 5 sections. The soil parameters have to be verified by means of plate baring tests for example.

Watertight liner stability criteria:

The minimum slope for placement shall comply with good design and engineering practice. Laboratory tests shall be performed in order to confirm membrane stability over the underlying layer in dry and wet conditions, such as EN ISO 12 957/2, 2004 or the shear box tool.

Moreover, the following Factors of safety shall be fulfilled:

- >1.5 regarding uplift with natural water table
- >2 regarding Wind effect
- >1.5 regarding Uplift with gas
- >1.5 regarding potential soil swelling effect
- >1.3 regarding loss of water tightness (due to extension) under water pressure

The liner drainage shall be compartmentalised in order to detect the location of leakages. A minimum of 9 compartments is required.

Reservoir Bottom Outlet valve:

In the extreme event when (i) a seismic event damages the membrane and puts the embankment at risk and (ii) the Powerhouse is out of order, it must be possible to lower the reservoir elevation by opening of the reservoir Bottom outlet valve. The criterion to be applied is to lower the reservoir elevation from FSL to an elevation where the total thrust on the upstream batter is halved in less than 8 days, with no inflow. The downstream restitution place shall be engineered (stilling basin, rockfill protection) in order to avoid erosion of the natural ground.

The liner design:

Two options for the reservoir lining are permitted:

- Alternative 1 - Asphalt lining: The asphalt lining shall be associated with an underlying drainage layer existing of gravel with a minimal thickness of 30 cm.
- Alternative 2 – PVC geo-membrane (white): The liner shall be associated with an underlying protecting non-woven geotextile min. 500 g/m² and an underlying drainage layer existing of gravel with a minimal thickness of 20 cm.. The fixation system of the liner shall be well designed with anchor trenches, to withstand the uplift wind forces.

Other materials for the reservoir lining are not allowed.

Long term performance:

The liner chemical composition or design shall be consistent with the life duration specified in chapter 4.1.1.2, mainly regarding UV attack.

For geo-membrane liner type, at the end of the construction, the membrane shall be exempt from folds except in dedicated places where justification is provided by the Contractor (for settlement provision or any other technical reason).

The design will be such that the drainage system that shall monitor the leaks through the liner shall not be influenced by water coming from any rise of the ground water table up to a 50 years ARI event.

Settlement criteria:

Differential settlements between the embankment and concrete structures, and between different parts of the embankment (due to foundation materials or embankments materials) shall be consistent with a safe behaviour of the watertight membrane in all respects regarding folding, tearing, tension and other parameters as warranted by the liner manufacturer.

Monitoring:

Drainage discharge, piezometers inside the embankment, vertical extensometers for the embankments / foundation of the dam and concrete structures settlements and displacements shall be measured and monitored in order to check the safe behaviour of the structure. The number of devices shall comply with the Basic Design pertinent drawings.

Crest protection:

Whichever protection is selected for the membrane, particular devices shall be taken into account in order to avoid any overflow of the crest under wind wave action. In case of parapet wall, the structure shall be stable under wind wave action, according to the following criteria:

Load Case (including wind wave action)	Sliding FS	Overturning criteria Minimum base area in compression %	Minimum Bearing Capacity FS
Water level = FSL	1.5	100	3
Water level = Reservoir crest elevation	1.33	75	2
FSL + OBE	1.3	75	1.5
FSL + MCE	1	Resultant within base	>1

Design of the crest:

A super elevation (transversal slope) shall be managed in order to direct the run off towards the reservoir.

Optional floating cover:

There is a possibility that the Owner decides that a floating cover will be installed at the Lower Reservoir. Such decision, if and when relevant, shall constitute a Change Order in accordance with the provisions of the Agreement.

5.1.15 Substation platform

The backfilled platform that shall shelter the substation will be compacted such a way or will be given sufficient time for consolidation such that, once handed over to the electrical team, the settlements fulfil the equipment requirements. A permanent peripheral drainage gutter (and associated exhaust towards natural ground and anti-erosion protection) shall prevent from run-off erosion.

5.1.16 Cut and Cover section Main Access Tunnel

A pre-cut section with an embankment inclination of 2:1 (horizontal: vertical) is designed to ensure the construction of the tunnel portal in the construction phase. The portal stays within the blue line boundary.

The final portal building is situated some 49 m south east of the construction portal. It is required to stay within the “red” line boundary with the final portal building. The section between the final portal building and tunnel portal during construction is built with a concrete structure and has to be covered afterwards with fill including a landscape rehabilitation be-tween the end of the existing avocado orchard and the end of the cut and cover section. The land rehabilitation has to be done in coordination with the owner.

5.1.17 Underground works minimum requirements

The following table specifies the minimum requirements to be applied for the support of the permanent or temporary works.

Permanent	All	Span < 6 m	50mm shotcrete (if necessary prefer fibre reinforced shotcrete than mesh)
		6 m < Span < 8 m	100mm shotcrete + mesh (applied on 90° on the crown)
		Span > 8 m	Crown : 150mm shotcrete + mesh over 90° on the crown
			Walls : 100mm shotcrete + mesh
Temporary	Shaft/Walls	-	50 mm shotcrete + mesh or steel fibres
Temporary	Tunnel	D > 4 m	Mesh only (applied on 90° on the crown)

5.1.18 Permanent excavated slopes

The stability of the open cut slopes in both overburden soils and rock will be designed for both circular sliding failure surfaces and sliding wedge failure surfaces for the following loading conditions:

- Self-weight
- Fully saturated under steady state seepage
- OBE
- MCE

The minimum factor of safety of the slopes for normal loads with respect to overall sliding in the overburden soils and rock in open cut excavations are the following:

Load case	Minimum Factor of Safety
Long term steady state seepage taking into account any drainage system provided as part of the works	1.5
Long term steady state seepage assuming any drainage system provided as part of the works is completely ineffective	1.3
Construction stage	1.3
OBE under steady state seepage taking into account any drainage system provided as part of the works	1.3
MCE under steady state seepage taking into account any drainage system provided as part of the works	1.0

5.1.19 Project and public roads

The use of public roads is subject to the instructions in the building permit and has to be coordinated with the Public Roads Authority and the Police.

All public roads in the vicinity of the project, used by the Contractor during the construction period, shall be restored to their original pre-construction status. Agricultural roads used by the Contractor during the construction period shall be restored to their original pre-construction status according to standards such as used by Keren Kayemet (JNF / KKL).

All other designs and construction requirement shall be in accordance with Israel Road Design Manual as published by the Ministry of Transportation and, when the Manual does not provide the required information, the applicable AASHTO standard specifications shall apply.

Rainfall intensities to be used for the design of culverts and drainage for platforms and related structures of the following Permanent Works shall be designed for:

- an equivalent rainfall of 65 mm/hour for concentration time of one hour or 78 mm/hour for concentration time of 20 min for the Power House and Switchyard protection
- an equivalent rainfall of 24 mm/hour for concentration time of one hour or 47 mm/hour for concentration time of 20 min for all the other sections of works

5.1.20 Soil management and spoil disposal areas

The Contractor shall coordinate and manage all the spoils generated by the works. Not later than 4 months after civil work contracts award, the EPC Contractor shall issue to the Owner non-objection a document explaining the management of all the materials to be excavated, backfilled, transported, and put into spoil areas by the different subcontractors.

Such a document shall be updated on a regular basis, if a change in materials quality requires a planned management modification.

Location of dedicated spoil disposal areas (sites) shall be provided by the Owner for the excess clay excavated from the Lower Reservoir area. Disposal areas for excess rock from the Upper Reservoir area and from the Underground Works, and sludge excavated from the existing Lower Reservoir shall be provided by the EPC Contractor, but it is the Contractor`s responsibility to coordinate these sites.

All disposal expenses will be carried by Contractor up to 15 km distance for excess soil and rock, and with no distance limits for construction waste.

The areas shall be stable, free of detrimental erosion created by rainfall and they have to be drained. The minimum factors of safety shall be the following:

- ≥ 1.5 under steady state conditions
- ≥ 1.2 with Operating Basis Earthquake (OBE)
- > 1.0 with maximum credible earthquake (MCE).

5.1.21 Pumpturbine spiral casting

The spiral cases and draft tubes of the pumpturbines shall be embedded in concrete. Although the spiral casing is to be embedded in concrete it shall be designed to withstand the internal pressure due to the maximum head (including maximum water hammer) without any support from the surrounding concrete.

The maximum permissible overpressure in the spiral casing is to be determined by the Contractor and submitted to the Owner for non-objection.

The spiral cases shall be pressure tested at 150% of the maximum operating pressure as determined per the hydraulic transient study.

During concreting of the spiral case shall be pressurized at 50 % of the maximum operating pressure.

Concreting of the spiral case can only start after finalized and accepted pressure test of the spiral case equipment.

5.1.22 Water quality and water processing

The water quality of the upper and lower reservoirs includes the following parameters:

- Concentration of chloride (Cl) and sulphate (SO_4) with respect to corrosion.
- Concentration of solid particles with respect to abrasive erosion.
- Hardness (concentration of $CaCO_3$) with respect to deposit inside equipment.

Based on project data regarding water quality and a preliminary concentration calculation (evaporation and refilling process) the owner decided that within an operation period of 23 years starting on the Handing Over Date no water processing is required to fulfil the following water quality criteria:

- Concentration of chloride ≤ 135 mg/l.
- Concentration of sulphate ≤ 900 mg/l.

- Concentration of solid particles ≤ 20 ppm.
- Hardness ≤ 700 mg/l.

All permanent steel equipment of the power plant shall be supplied and installed with a corrosion protection based on the expected water quality over the operation period depending on the water processing defined above.

In addition the design of cooling primary and secondary circuits shall be such, that water hardness shall have a minimum impact on the overall availability of the power plant for the whole project life.

Plate exchangers of the first stage cooling system will be equipped with efficiency monitoring devices in order to optimize the cleaning process.

5.1.23 Submission of detail design documents

Any detail design documents as:

- Guideline drawings,
- excavation drawings,
- formwork and reinforcement drawings,
- structural and hydraulic design reports,
- method statements with material specifications,
- etc.

have to be sent to the Owner and the Owner's Engineer prior execution for non-objection, in accordance with design review timeline in EPC Contract.

Material test and quality control protocols have to be continuously submitted to the Owner's Engineer for non-objection. Type of tests is specified in the particular civil specifications (Section V, Volume 2).

5.2 GENERAL COMMENT TO MONITORING OF CIVIL WORKS

The required monitoring of the civil works, especially dams and underground works is described in the technical specifications and the basic design reports and drawings (Volume 2, Volume 3).

The monitoring program of the upper reservoir fill dam is defined on the drawing MANARA/BD/02/007 and of the lower reservoir zoned embankment dam on the drawing MANARA/BD/CD/03/008. Monitoring instruments, installation, operational and maintenance procedures are defined in the Civil Technical Specification: TS-11 – Embankment Construction and Backfill, Instrumentation. The instrumentation of both reservoirs has to start immediately after the construction of the dams and has to be followed during commissioning and operation.

The monitoring of the underground works is specified in the Civil Technical Specification: TS-06 – Underground Excavation. The deformation measurements, convergence and extensometer measurements, will be defined during the detail design phase and also during the construction works. In the tunnels and shafts, the convergence measurement system with 5 points per measurement cross-section is specified. Additional sections could be ordered by the Owner on geologically critical places, with a change order. The convergence measurements frequency and duration is defined in the Technical Specifications. In the cavern additional to the convergence measurements at least four extensometer measurement sections are foreseen. In each section, seven triple extensometers are foreseen. Definition of the measuring cross-sections and position of each extensometer will be defined in the detail design phase and adjusted to the local geological conditions. In the extensometer cross-sections also the convergence measurements have to be performed. The measurements have to be performed immediately after installation (as near to the excavation face as possible). The measuring frequency and duration is defined in the Technical Specifications. The extensometer should be installed allowing also automatic measurements during the operation. The extensometers must be installed on the places that during operation will not be covered by final lining or fixed installed equipment.

Additional to the deformation measurements, the water inflow in the underground structures must be recorded by the Expert Geologist during the whole construction period. The seeped water amount will give additional information to design and dimensioning of the permanent drainage and pumping system.

The forces in the pre-stressed anchors in the cavern have to be measured continuously after the anchor installation and also during the operation. At least half of all installed pre-stressed anchors should be monitored. The measurement frequency can be adjusted on the decay of the force change in the pre-stressed anchors.

5.3 DESIGN CHANGES DUE TO DETAIL DESIGN

The EPC acknowledge that in the course of the detail design, changes of the basic design may be required for different project's components. The main drivers for design changes can be: design optimization, changes due to input from specific equipment components, regulations from authorities, etc.

The consequences of any detail design change impacting the basic design should be checked and confirmed between the Owner and the EPC Contractor.

5.4 DESIGN REQUIREMENTs FOR EM WORKS

The general design criteria for electromechanical and hydraulic steel works is defined in the document “General EM, HM Specifications” Volume II Section VI_A20_GTS; chapter 2.5.

All requirements have to be fulfilled for both runners → 156 MW for the current works, and the optional 220 MW[1]. This means that for the 156 MW runner the generation and pumping power is 156 MW and for the optional 220 MW runner the generation and pumping power is 220 MW.

[1] An option mode subject to the allocation of additional quota, receipt of all required consents, approvals and permits, and the Owner’s exercise of its option to increase the installed capacity

5.5 DESIGN REQUIREMENTS FOR PERMANENT WORKS

The table below specifies the minimum physical requirements for the permanent works:

Item	Minimum Physical Requirement
Upper reservoir	
Full Supply Level (FSL)	+737.00 masl
Minimum Operating Level (MOL)	+712.50 masl
Type	Earth and/or rockfill embankments watertight with an upstream impervious asphalt sealing and/or geo-membrane
Crest level	FSL + wind/wave allowance + freeboard
Minimum design requirements	Membrane to have minimal leakage in accordance with applicable standards and good design, engineering and construction practices.
Dam instrumentation	Instrumentation consistent with international dam safety practice shall be installed to monitor and record performance of the dam behavior. Such instrumentation is not required to be connected to the powerhouse SCADA system. Particular care shall be taken on leakage detection and monitoring and displacement measurements.
Bottom outlet	A bottom outlet on the south-western part of the upper reservoir is installed to lower the reservoir water level in case of the following extreme event situation: • a seismic event damages the membrane and puts the embankment at risk • the powerhouse is out of order • possible military events For this situation it must be possible to lower the reservoir water level. The criterion to be applied, is to lower the reservoir water level from FSL to an elevation where the total thrust on the upstream dam body is halved in **less than 8 days**.
Upper water intake	**Electromechanical equipment** Trash racks to prevent debris to enter the waterways during operation. No trash racks cleaner needed since at the pumping mode, the trash rack will be flushed clean. A differential pressure measurement shall be installed. Upper safety gate of roller gate type operated by a hydraulic servomotor and an oil pressure unit with accumulator equipped with a “filling position” locking device for control of the filling of HP waterways. Functions: Able to cut the free flow maximum discharge in turbine mode under failure conditions and to close in emergency situation without any energy supplied. In pumping mode, a special autonomous mechanical locking

Item	Minimum Physical Requirement
	system fitted on the fix and mobile parts of the gate shall prevent the gate to close. Upper stoplogs for maintenance of the upper gate to be handled with a mobile crane on truck when needed. Electric supply from local distribution grid to supply the gate hydraulic station, control and monitoring system, lighting and sockets, external lighting, CCTV system. An emergency diesel and UPS supply for the gate hydraulic station and control system is foreseen. The emergency diesel and UPS supply are situated in the building (container) separate to the main gate building. Redundant Water level measurement devices connected to the power-house control and monitoring system. The devices shall be installed to avoid any common failure mode (separate pits, separate cable route to the reservoir control building). Redundant Control and monitoring cables from the powerhouse SCADA system routing along with the HP waterways (in embedded HDPE pipes) Electric and hydraulic station be housed in a dedicated operating building
HP & LP waterways	Provision shall be made in order to avoid, that existing springs situated in the close vicinity of the Project (up to 2 km away from the lower intake location) be dried up, totally or partially. The HP tunnel, HP shaft and LP tunnel shall convey flows in both turbine and pumping modes between the upper and the lower reservoirs. Near the powerhouse, the water shall be distributed through a HP and LP manifold system to the unit. The requirements of these waterways include the following: Structural design of the waterways concrete lining Reinforced concrete lining is designed in order to reduce the cracks opening through the concrete lining down to **0.2 mm** Grouting In the LP waterway consolidation grouting shall be carried out along the route of the tunnel wherever it is necessary to improve areas of poor ground behind the linings, to assure the integrity of the linings and to reduce the possibility of water loss due to seepage through the surrounding rock. Void grouting shall be carried out in tunnels in order to avoid that voids remain at the crown. Steel Lining Present no draining system along the final lining of the high and low pressure power waterway is foreseen. This is the preferred solution. For the steel lining the maximum pressure of the ground water for each section has to be considered and designed accordingly.

Item	Minimum Physical Requirement
	Alternatively the steel lined portion of the waterways may supplied with a draining system in order to reduce the external pressure and, consequently, the steel lining thickness. This system has to be permanently open, with provision made for routine access, monitoring and maintenance (including power, lighting and ventilation). A minimum corrosion allowance of 1.0 mm shall be added to the steel thickness required for stress conditions. The internal surface of the steel lining shall be corrosion protected. The protection vs. corrosion of the steel lining shall be designed taking into account the protection system selected for the pump-turbine and associated components to eliminate a potential conflict between the two and shall be sent to the Owner's non-objection. The allowance for corrosion used in the calculation notes shall be substantiated taking into the water quality and the expected long term behavior of the protection system of the steel lining. <u>Plant and personnel access</u> Provision shall be made for access for mobile plant and equipment, such as elevated work platforms, air compressors, welders, diesel generators and lights, light tractors and trailers and personnel to carry out inspection and maintenance work to all parts of the HP tunnel, LP tunnel and manifolds. Access to the drainage system (if any) shall be possible without shutting down the power plant or curtailing generation.
Surge tank	The surge tank shall smooth down pressure transients in the low pressure power water way system during start-up and load rejection operation of the power plant in both turbine and pumping modes. Furthermore the surge tank shall provide suitable governing stability characteristics of the system. The requirements of the surge tank include the following: <u>Lining</u> The surge tank shall be concrete-lined. Reinforced concrete lining is designed in order to reduce the cracks opening through the concrete lining down to **0.2 mm** maximum At the top of the surge shaft, a service water tank shall provide the necessary firefighting water reserve. Feeding of the service tank shall be made through the Powerhouse sump pit drainage discharge with an overflow managed inside the surge shaft. <u>Design Criteria</u> For any credible operation of the power station, the surge tank access gallery shall be designed such that the air velocity resulting from the worst case scenario water fluctuation never exceeds 50 km/h.

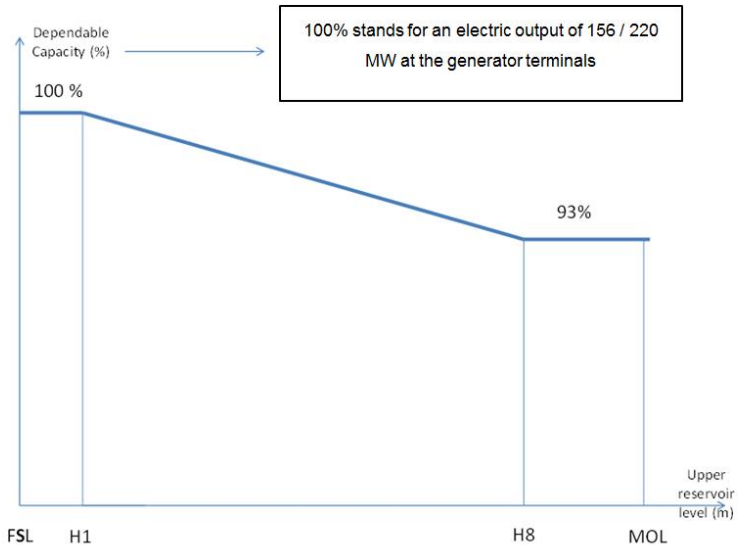
Item	Minimum Physical Requirement
	For any credible operation of the power station, the surge tank shall be designed such that the water level in the shaft does not: (i) rise within 4 m of the top of the surge tank for standard load cases and 1.5 m for extreme load cases and resonance load cases; nor (ii) fall to within 4 m of the bottom of the surge tank or the level required to prevent ingress of air into flows in the underground conduits. The pressure drop at the surge tank – LP tunnel intersection (throttle area) is never be allowed to be negative.
Underground structures - General	**Hydraulic Civil works (water ways)** (i) To safely withstand extremes of internal and external pressure at all points. (ii) To be provided with a surge tank sized to accommodate worst case transient hydraulic regimes, limit pressure transients to acceptable levels, and provide suitable governing stability characteristics. **Civil works** (iii) To permit access for plant and personnel for maintenance. (iv) At the location of faults crossing, where movements may occur, provision shall be made to allow a safe behavior of all the equipment that cross the faults, such as (but not limited to) vent pipes, water pipes, electrical cables.
Underground power house *Pumpturbine unit* Rated discharge in turbine mode Rated discharge in pump mode Rotational speed Runner elevation setting	**Electromechanical equipment** One vertical axis pumpturbine with Francis runners (156 MW or optional 220 MW[2]) complete with main inlet valve and draft tube roller gate. Unit to be designed manufactured and installed to achieve good state of the art international hydropower standard with respect to noise, vibration and metal loss, and submergence criteria. The main inlet valve shall be designed to close in any flow and head combinations. approximately 37.1 m^3/s approximately 29.8 m^3/s 750 rpm 2.0 masl
Underground Power House	

Item	Minimum Physical Requirement
Motor-generator Rated output Rated power factor in generator mode Rated voltage	One (1) synchronous motor-generator with excitation system and automatic voltage regulator rated with 260 MVA 0.85 o.e. / 0.90 u.e. 15.8 kV ±6%
Underground Power House *Unit power transformer* Rated power Voltage ratio Short circuit ratio (%) *Starting in pump mode* Start-up time *Isolated phase bus ducts (IPB)*	 One (1) three-phase power transformer 265 MVA 161/15.8 kV ; on load tap changer +/- 7x1% 12.5 % (at medium tap) indicated value. Final value up to detail design. One (1) Static Frequency Converter (SFC) 340 seconds from 0 rpm to full power pump operation One (1) three phase IPB connecting the motor-generator to the unit transformer, equipped with generator circuit breaker, phase reversing switch, surge arrester, VTs and CTs as well as grounding switches
Underground Power House *Balance of Plant*	<u>Auxiliaries electrical supply</u> Normal supply tapped from the unit MV bus bars through auxiliaries transformers. When the unit is not in operation a back-up supply can be taken from the local 22kV distribution grid through step-down transformers. In case of emergency a diesel generator, which is located at the switchyard operating building, will supply the essential loads. An UPS system feeds all control and communication equipment. <u>Auxiliary systems</u> HVAC system Smoke exhaust Firefighting and fire detection Lighting and small power outlets Emergency lighting Telephone and communication system Video surveillance and security system Cranes and Elevator Drainage and dewatering systems for the entire powerhouse Cooling water system for units (bearings and generators), power transformers and Static Frequency converter Shaft seal watering system Lubricating oil systems and accumulators

Item	Minimum Physical Requirement
	Compressed air systems (HP & LP)
Power house handling equipment	Main crane capacity 245 tons + auxiliary crane 15 tons for the main crane and other equipment handling devices (for pumpturbine parts, main inlet valve, draft tube gate and electrical equipment as needed);
Provision for hazards within the Powerhouse	Risk of Fire: Approval of the designed layout by the Israeli Fire brigade with provision for an emergency escape corridor in the access tunnel. Risk of Flood: Sizing of sump pit and pumps considered with the following requirements: • Breach of the by-pass pipe of the main inlet valve • Dewatering of the high pressure power water way ~6500 m³ in <15 h • Dewatering of the lower pressure power water way ~17500 m³ in <15 h Risk of oil spill: Installation of an oil separator prior to discharge into the sump pit
Requirements from the Israeli Fire Brigade	The Contractor is required to receive Fire Brigade approval to the safety plan of the power plant, substation and Access roads and to fulfil all Fire Brigade requirements as presented to the Contractor during the construction permit approval process. The Contractor shall be responsible for all payments to the fire brigade for reviewing the design and onsite inspections. Specific Fire Brigade requirements to be considered: 1. Fire fighters control panels: The Fire Brigade may require placing a control panel for smoke management at the entrance tunnel. 2. CFD simulation for smoke behavior in the access tunnel and power cavern 3. Dedicated power generator for the emergency systems in the cavern and access tunnel may be required. 4. Electrical panels fire suppression. According to Fire Brigade internal documents all electrical panels rated 63A and above require smoke detectors and all 100A and above panels require fire suppression systems (inert gas suppression) .The Fire Brigade forfeit this requirement if sprinkler systems or volume inert gas suppression systems are installed in the electrical room.
Main Access tunnel Minimum size Equipment/Functions	To fit the transportation size of the largest equipment or elements of the Power Plant and operation and maintenance equipment, as determined by the EPC Contractor. Lighting and sockets Ventilation inlet Drainage pipes embedded in the main access tunnel Main access and emergency escape exit for personnel Smoke exhaust

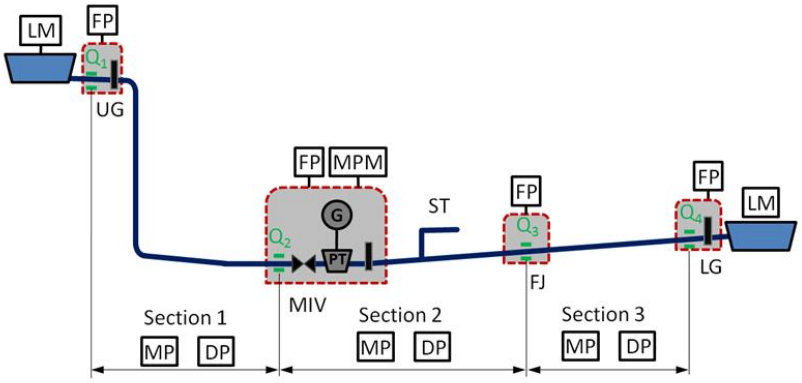
Item	Minimum Physical Requirement
Cable gallery *(combined with access tunnel)*	161 kV dry cables running suspended in the cable gallery MV, LV and control cables installed in embedded pipes in the bottom slab Lighting and sockets Firefighting system (High pressure water spray system) Ventilation and smoke exhaust Drainage pipes routing Back-up escape exit for personnel
161 kV Switchyard	161 kV outdoor substation with single busbar and two double system connections to IECo grid. Connection to the distribution grid (22kV) for auxiliaries supply of the operating building and the PH Grid connection Agreement: 156 MW_{el} at the motor-generator terminals for the 156MW runner and 220 MW_{el} at the motor-generator terminals for the 220MW optional runner[2]
Operating buildings	Substation operating building including IECo dedicated section. Power plant and substation operating building including: Operating rooms such as control room, telecom room, computer systems room Offices and convenience such as offices, conference room, visitors' room, changing room and documentation/archives room + toilets, kitchen, Technical rooms such as diesel room (substation building only), workshops and small equipment, oil & dangerous goods storage area, mechanical & electrical spare parts storage, battery rooms, MV switchgear ((substation building only) and LV distribution boards, ventilation & air conditioning,... Elevator, Visitors centre, etc… All buildings shall be equipped with lighting, ventilated and air-conditioned,
Lower water intake	**Electromechanical equipment** Trash racks to prevent debris to enter the waterways during operation. No trash racks cleaner needed since at the generating mode, the trash rack will be flushed clean. A differential pressure measurement shall be installed. Lower safety gate of roller gate type operated by a hydraulic servomotor and an oil pressure unit with accumulator equipped with a "filling position" locking device for control of the filling of LP waterways. Functions: Able to cut the free flow maximum discharge in pumping mode under failure conditions and to close in emergency situation without any energy supplied. In turbine mode, a special autonomous mechanical locking system fitted on the fix and mobile parts of the gate shall prevent the gate to close.

Item	Minimum Physical Requirement
	Lower stoplogs for maintenance of the lower gate to be handled with a mobile crane on truck when needed. Electric supply from plant operating building, lighting and sockets, external lighting, CCTV system. Redundant Water level measurement device connected to the powerhouse control and monitoring system Redundant Control and monitoring cable from the lower reservoir to the plant operating building SCADA system routing in the D/S connection.
Bottom outlet	A bottom outlet on the south-eastern part of the lower reservoir is designed to lower the reservoir in case of the following extreme event situation: • a seismic event damages the membrane and puts the embankment at risk • the powerhouse is out of order • possible military events For this situation it must be possible to lower the reservoir elevation. The criterion to be applied is to lower the reservoir elevation from FSL to an elevation where the total thrust on the upstream dam body is halved in **less than 8 days**.
Lower reservoir	
Full supply Level (FSL)	80.70 masl
Minimum Operating Level (MOL)	73.25 masl
Type	Earth and (or) rockfill embankments watertight with an upstream impervious asphalt sealing or geo-membrane
Crest Level	FSL + wind/wave allowance + freeboard
Minimum design requirements	Membrane to have minimal leakage in accordance with applicable standards and good design, engineering and construction practices. The last 50 cm (measured perpendicular to the slope) of the material forming the external face of the embankment shall be sound and not weathered. Los Angeles (LA) value of the material shall not exceed 35.
Embankment instrumentation	Instrumentation consistent with international dam safety practice shall be installed to monitor and record performance of the embankments. Such instrumentation is not required to be connected to the powerhouse SCADA System. Particular care shall be taken on leakage detection and monitoring, piezometry control and settlement measurements.
General power plant capacity	Definition of the dependable capacity (MW) The power plant and namely the pumpturbine and its governing system shall be designed, constructed and commissioned in order that the capacity at the generator-motor terminals when generating continuously from full supply level (FSL) to minimum operating level (MOL) of the upper reservoir follows the graph here below:

Item	Minimum Physical Requirement
	 *Dependable Capacity of the Power Plant as a function of the upper reservoir level* With: • H1 is the exact duration of 100% dependable capacity • H8 being the upper reservoir level after 8 hours generation per the graph (linear capacity decrease between H1-100 % and H8-93 %). H1 and H8 will be further determined according the item 3 of the Appendix 1 – Acceptance Test Procedures. For the avoidance of doubt the upper reservoir level is used for practicality instead of gross water head (see Item 3 of Appendix 1) The criteria has to be fulfilled for 156MW runner and for optional 220 MW runner[2]..
Hydraulic protection system	Sensors are installed along the power waterway, used for the control system of the PSPP as well as for the flood protection system of the waterway system. All sensors are installed redundantly. **Parameter** / **Type** / **Accuracy** Water level / Pressure sensor / ≤ 0.02% Discharge / Ultrasonic / ≤ 1.0% Pressure / Pressure sensor / ≤ 0.5% Flood protection / Conductive detector /

[2] An optional mode subject to the allocation of additional quota, receipt of all required consents, approvals and permits, and the Owner's exercise of its option to increase the installed capacity

Item	Minimum Physical Requirement
	The sensors are installed at neuralgic locations along the power water way system. Below figures shows the principle arrangement of the system, and provides a list of the sensors installed at different locations.



FP	Flood protection
MPM	Max. pressure measurement
MP	Maximum protection (Monitoring of max. discharge)
DP	Differential protection (Comparison of inflow and discharge)
LM	Level measurement
MIV	Main inlet valve
UG	Upper reservoir gate building
LG	Lower reservoir gate building
ST	Surge tank/tunnel
FJ	Flexible joint chamber

The control components of the hydraulic protection system are installed in the power cavern. In case of an emergency the closing of related valve/gates and the safe shut down of the hydraulic unit will be triggered automatically.

5.6 PERFORMANCE OF THE POWER PLANT

5.6.1 Required levels of performance

5.6.1.1 Final performance as per IEA criteria (provisional license)

	Minimum performance criteria	Figures	Definition / Comments
1	Installed Capacity or maximum output when upper reservoir is at FSL Note: Installed Capacity must be sustainable for a minimum of 1 h when starting generation from FSL of the Upper reservoir.	**156 MW / 220 MW (optional)[3]**	Measured at the Motor-generator terminals, 2 capacities for the related runners current mode and optional mode)
2	Minimum availability	94% 1st year, 95% 2nd year, 96% afterwards, taking into account a "roll forward" mechanism as specified in Standard 127, Article C (e) of the IEA Standards.	Theoretical opportunity of running the unit no matter whether it is running or not. The unit is available if it is ready to run and be synchronized.
3	Minimum continuous production time from FSL of the Upper reservoir at full load, during which the dependable capacity shall not be less than the Installed Capacity minus 7%.	8 hours	To be compliant with upper reservoir capacity and nominal discharge of the turbine
4	Maximum pumping time to refill Upper reservoir to FSL after production of 8 h per item 3 above.	10.7 hours = 10h42min	To be compliant with lower reservoir capacity and nominal discharge of the pump (according to IEA)
5	Minimal Weighted average cycle efficiency	76%	η **global** (view from the grid) = ratio of energy generation in MWh versus Energy consumption in MWh for the same volume of water, in various partial loading conditions during generation using the weighting factors defined in Acceptance Test Procedures.

[3] Optional mode subject to the allocation of additional quota, receipt of all required consents, approvals and permits, and the Owner's exercise of its option to increase the installed capacity

	Minimum performance criteria	Figures	Definition / Comments
6	Maximum load shedding time	0.1 sec	The load shedding time is the time to trip the unit after detection of an electrical fault (internal in the machine).
7	Withstand of grid faults	as agreed between Employer and Contractor with IECo during the technical coordination process	The Unit will stay connected to the grid, even in case of an 3-phase short circuit in proximity to the connection point.
8	Maximal time needed to start generation from: turbine rotating in water and synchronized (churning period)	12 sec	time intervall required between a synchronised unit until the start of generation
9	Minimal load change rate from minimum partial load (at the prevailing water head) to dependable capacity or ramp-up rate.	2.5% of installed capacity per second	Slope of the load variation Load increase ratio from Minimum partial load to Dependable Capacity
10	Mode changes times	See diagram below	
11	Minimum* partial load (at any prevailing water head)	50% of the installed Capacity	

* For the avoidance of doubt the minimum partial load at any water head shall not be more than 50% the installed Capacity.

<u>Mode changes times:</u>

Each reversible unit shall be capable of safely completing the following maximum changeover times (according to IEA):

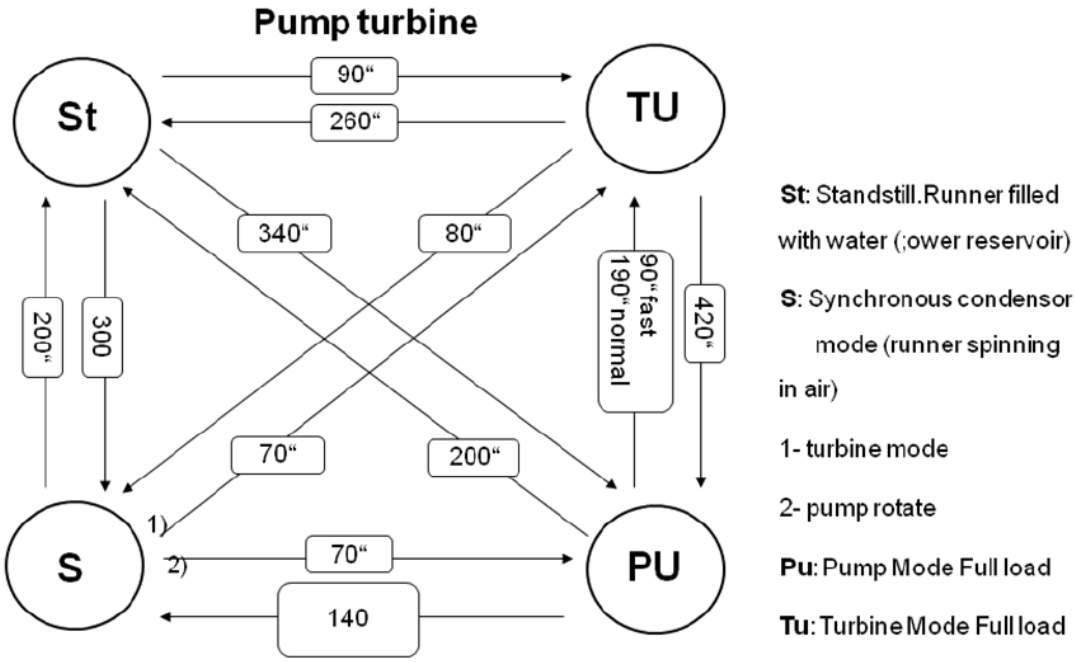


Figure 5-3: Mode change times pump turbine

Whereas the following definition are agreed:

Standstill: is reached when speed is 0 rpm

- MIV closed, distributor closed
- Waterways filled, Maintenance gates open
- HV-side of transformer energized
- Governor pressure tank filled and pressurized
- Auxiliary systems are off (slowest auxiliary equipment is allowed to stay in operation 24h/7days)

Synchronous condenser mode:

the unit is connected with the grid in no-load condition

- is reached when MIV is closed, distributor is closed
- is reached when draft tube level set point was reached

Pump mode:

is reached when the pump is at rated power, for 1 min stable in a band-width of Pn ± 5%

Turbine mode:

is reached when the turbine is at rated power, for 1 min stable in a band-width of Pn ± 5%

5.6.1.2 Civil works

N°	Item	Required minimum guaranteed performance level
1	Upper intake gate leakage	The maximum gate leakage rate at FSL shall be **2** liters per meter of seal per minute, with maximum leakage per gate of **5** liters per minute.
2	Stoplogs for upper intake leakage	The maximum stoplog leakage rate at FSL shall be **2** liters per meter of seal per minute, with maximum leakage of the installed stoplogs of **5** liters per minute.
3	Upper reservoir membrane leakage	The maximum leakage under FSL shall not exceed a total of 250 m^3 per day and 35 m^3/day per longest drainage compartment.
4	Upper reservoir foundation for rock fill dam	For the foundation stripping of the top soil has to be executed in that way, so that a rock fill dam can be situated and withstand all load cases listed in chapter “design requirements”.
5	Upper reservoir minimum freeboard	A minimum freeboard of 1.80 m above FSL is required.
6	Differential settlement between upper intake and adjacent reservoir bottom surface	The maximum settlement between the upper intake and the adjacent reservoir bottom surface shall not exceed 5 cm (*) at the end of the warranty period. (*) Unless particular device and disposal is undertaken in order to compensate the detrimental effect of such settlement.
7	Stoplogs for lower intake leakage	The maximum stoplog leakage rate at FSL shall be **2** liters per meter of seal per minute, with maximum leakage of the installed stoplogs of **5** liters per minute.
8	Lower reservoir membrane leakage	The maximum leakage under FSL shall not exceed a total of 250 m^3 per day and 35m^3/day per longest drainage compartment.
9	Lower reservoir embankment maximum settlement	The maximum settlement of the crest of the embankment of the lower reservoir shall not exceed 10 cm at any place, at the end of the warranty period.
10	Evolution of the lower reservoir embankment settlement and minimum freeboard	The rate of settlements shall decrease by at least 30% after each year of monitoring and be such that, on the long term, a minimum freeboard of 1.70 m remains above FSL.
11	Differential settlement between lower intake and adjacent embankment	The maximum settlement between the lower intake (along the side retaining walls) and the adjacent embankment (along the embankment slope) shall be not more than 5 cm (*) at the end of the warranty period.

N°	Item	Required minimum guaranteed performance level
		(*) Unless particular device and disposal is undertaken by the EPC in order to compensate the detrimental effect of such settlement.
12	Evolution of the differential settlement between lower intake and adjacent embankment	Decrease by at least 30% of the rate of settlement after each year of monitoring.
13	Differential settlement along the embankment	The maximum settlement along the embankment of the reservoirs, within a distance of 10 m, shall not exceed 10 cm at the end of the warranty period.
14	Differential settlement evolution along the embankment	Decrease by at least 30% of the rate of settlement after each year of monitoring
15	Underground waterway concrete lining roughness	The concrete lining finishing shall be such that its equivalent absolute roughness (ε) shall not exceed 0.8 mm.
16	Underground waterway steel lining roughness	The steel lining finishing shall be such that its equivalent absolute roughness (ε) shall not exceed 0.05 mm. For convergent at the entrance of the spiral case and the spiral case, absolute roughness (ε) shall not exceed 0.03mm.
17	Main inlet valves	The maximum leakage is according to EN 12266-1 point A4.3 using the leakage rate **B.**
18	Draft tube gate (or LP gate) leakage	The maximum leakage rate at FSL shall be 0.05 liter per meter of seal per second, with a maximum total leakage per gate of 1,2 liters per second.

The detailed design studies shall specify the methodology proposed to provide and test the requirements.

5.6.1.3 Electromechanical equipment

Detailed required minimum guaranteed performance level are defined in technical data sheets of each chapter E&M particular technical specifications.

5.6.2 Measurement of level of performance

5.6.2.1 Equipment of the power plant

The performance as per IEA criteria will be measured during the acceptance tests after completion of works and commissioning tests in a dedicated testing sequence described in the Appendix [1] “Acceptance Test Procedures” of Israel Electric Corporation LTD. (IECo) according Volume 4 - General E&M Technical Specifications.

The permanent energy metering (inside power plant and the tariff metering point inside the switchyard), flow measuring system and SCADA system (including time

measurement) will be used for measuring the various parameters and recording the tests results.

The compliance with all IEA and IECo criteria and conditions will be checked. Tests measurements will be recorded and a comprehensive report produced.

5.6.2.2 Civil works

The performance for civil works shall be measured when the works are completed. Through dedicated design calculation reports to be issued during the detailed design, acceptance tests shall focus on the following:

- Head loss inside the hydraulic circuits (in order to prove the quality of the lining finishing). The roughness of the built circuits (concrete lined or steel lined) shall be calculated along three sections of waterways (one along the steel lined HP shaft, one along the steel lined HP tunnel, one along the concrete lined LP tunnel). The head losses shall be measured in turbine mode with 2 different discharges (maximum discharge and 70 % of the maximum discharge). For each of the three sections, the ratio “r” (head loss / Q2) shall be calculated. If the 2 calculated ratio “r” for each section differ by more than 5%, other discharges shall be used and associated head losses measurements recorded in order to reach the required scatter. The ratio “r” that will finally be selected shall be the average between the calculated 2 values. In order to be consistent with the required roughness, the head losses measures shall not exceed the following values, in cm/m for a discharge of 36.7 m³/s:

Waterway	HP shaft and tunnel	LP Tunnel
Lining	Steel	Concrete / steel alternative
Diameter (m)	3.0	3.8
Head loss (cm/m)	0.45	0.20

- LP power water way concrete lining works has to prevent water losses towards the surrounding ground. Once the Tunnel Filling Test (TFT) is completed, if the test does not show evidence that works have been completed according to appropriate industrial practices leading to a safe project (excessive leakage or brutal changes in the leak when internal pressure increases), then (i) investigation works may be undertaken upon Owner’s request thanks to the EPC Contractor equipment, (ii) commonly analyzed with the Owner and the EPC and conclusions drawn. If evidence is made that defaults exist, then the EPC shall have to perform remedial works on his own expenses and investigations done shall not be paid by the Owner. On the contrary, the EPC shall bear the investigations price. Such items (investigations such as drill holes, radar check ...) should be included in the unit rates list belonging to the Agreement.
- Steel lining underground works integrity. If the steel lining is designed in water table drained conditions, the monitoring of the drains discharge and existing piezometers shall fit the purpose (i.e. never show a trend that could lead to a

pressure greater than the design one at the end of the warranty period). If the steel lining is not drained, one piezometer for each 100 m long steel lined penstock shall be drilled (prior to the TFT) and monitored during the tunnel filling test, in order to check that the impoundment does not create any evolution of either discharge or pressure. Such piezometers shall finally be included inside the monitoring plan of the plant.

5.6.3 Performance measurement and monitoring equipment

5.6.3.1 Principles

As far as practicable the measuring equipment used for commissioning and acceptance shall be permanent equipment in order to allow monitoring of the performances of the power plant during the operation period.

When such equipment cannot reasonably be permanent, whatever the reason as substantiated by the Contractor, correlations between the measurements made using non-permanent test equipment and corresponding permanent equipment shall be established by the Contractor during commissioning and acceptance of the power plant.

Operation & Maintenance manuals for measuring and monitoring equipment will include inter alia requirements and method for testing and, where applicable, calibration of these equipment.

The above principles shall in particular be applied for:

- Pressure measurements used for the determination of the head losses in the different sections of the waterways and the gross water head (only the measurements allowing the monitoring of the overall head loss and gross water head is required to be connected to the SCADA).
- Facility flow measurement (see 5.6.3.2 for more details). Such equipment shall be connected to the SCADA.
- Electrical power and energy measurement at generator-motor terminals (connected to SCADA).
- Electrical power and energy measurement at delivery point (if the direct connection to the SCADA of IECo metering system is not allowed solutions shall be proposed by the Contractor).
- Electrical power and energy at the MV tapping for auxiliaries and SFC supply (class S metering is required).

5.6.3.2 Flow measurement

An ultrasonic flow measurement system shall be installed at a suitable location within the high pressure waterways in order to measure the facility flow in the two directions with a high accuracy.

The flow measurement system shall be designed and installed in order to meet the two following main requirements:

- Annex J of the IEC60041 standard “Field acceptance tests to determine the hydraulic performance of hydraulic turbines”.
- MTBF of over 20 years.

The Contractor shall provide a technical note substantiating the expected inaccuracy of the system at the design stage; such inaccuracy shall not be more than 1% in the following conditions:

- Flow from 25 % of the maximum flow in turbine mode (including if water velocity at such flow is below 1.5 m/s as per the standard) to 120 % of the maximum facility flow in turbine mode.
- Both in turbine and pump flow directions.

The criteria used in such note such as the regularity of the waterways geometry at the location of the measurement section shall be binding for the construction (limited to the measurement section).

An as-built note shall be prepared after verification of the measurement section including checking geometry by theodolite.

The measurement system shall be interfaced with the facility SCADA system in order to allow real time monitoring of the flow during operation.

The minimum acceptable configuration of the system is 4 paths – 1 cross plane configuration and must be sufficient to meet the required accuracy. .

The hydraulic efficiency of the pumpturbine will be measured with a thermodynamic measurement which further allows to calibrate the flow measurement system.

In all cases the system will be used for monitoring of the facility and unit efficiency and the head loss coefficient during operation period.

5.6.4 Guaranties on units and system

The warranty period shall be as specified in the Agreement.

The power plant shall reliably and safely withstand the effects and stresses arising from long-term commercial operation, as well as repeated transient operation, without excessive or undue degradation of performance, cavitation or vibrations damage, or excessive and irregular maintenance requirements.

5.7 ALTERNATIVES TO THE PROJECT

5.7.1 Forbidden alternative

The following alternatives are forbidden:

- Hydraulic circuits (HP or LP waterways) non thorough lined with fully welded steel linings or concrete linings.
- High pressure shaft partially only concrete lined.
- Performing works outside the construction site area, unless otherwise expressly specified under the Agreement or the Owner's requirements.

5.7.2 Authorized alternatives

- Upper reservoir: The tightening layer of the reservoir can be executed with a PVC geo-membrane alternative. The fixation systems against loading as wind loads, uplift etc. has to be verified in detail (see chapter 5.1.5). Provided solution must be resistant on vehicle traffic needed in case of maintenance and repair. A HDPE tightening layer alternative must be discussed with the Owner for non-objection. References for projects in operation with good operation for the HDPE solution have to be provided.
- Lower reservoir: The tightening layer of the reservoir can be executed with a PVC geo-membrane alternative. The fixation systems against loading as wind loads, uplift etc. has to be verified in detail (see chapter 5.1.14). Provided solution must be resistant on vehicle traffic needed in case of maintenance and repair. A HDPE tightening layer alternative must be discussed with the Owner for non-objection. References for projects in operation with good operation for the HDPE solution have to be provided.
- Low Pressure Tunnel: A solution with steel lining of the LPT can be executed. The inner diameter of the LPT can be reduced under the premise that the hydraulic losses will not increase. The design requirements for the steel lining are the same as for the high pressure waterway described in 5.1.7.
- Particular attention shall be given during the Proposal Evaluation Process to alternatives that include inclined waterways with a slope exceeding 15%. If such an option is selected by the EPC Contractor, a risk analysis shall be issued in order to appraise associated contingencies.

6 CONSTRUCTION REQUIREMENT

6.1 MANUFACTURING, TRANSPORT AND INSTALLATION

6.1.1 Manufacturing

All materials used in the manufacture of the various equipment supplied shall be selected as the technically most suitable for the purpose for which they are used, considering strength, resilience, durability and other physical properties, as well as best engineering practice and comply with the Israeli Standards and Specifications.

6.1.2 Transport

The Contractor shall prepare all plant, devices and materials for shipment to protect them from any damage in transit, and shall be responsible for and make good all damages due to improper preparations, loading, unloading or shipment.

The Contractor shall also be responsible for obtaining from the local railway or highway authorities and the police any permit that may be required for the transport of loads exceeding the normal gauges.

The overall transport from the factory to the project site are part of the scope.

6.1.3 Installation and Erection Works

All work shall be performed in accordance with the most advanced practice in engineering for each class of equipment and completed in a thorough workmanlike manner following the best modem practice in the manufacture of high grade equipment. All work shall be performed by the skilled workers or specialists.

6.2 PROJECT MANAGEMENT

6.2.1 General

The Contractor shall appoint a long (well) experienced project manager ("PM") with functional and decision authority who is fluent in English (written and oral). This project manager must coordinate with the other entities involved in the Project to the extent necessary and shall be available at all times for the entire duration of the project.

The appointment or change of the PM must be approved by the Owner.

Site management of the suppliers involved in the project shall have several years of experience in the relevant disciplines.

All key project team members responsible for design, installation and commissioning must be able to demonstrate long-term professional experience of in the corresponding area. In addition, they must have completed several projects with similar activities in comparable positions.

The project team will be subject of Owner´s non objection.

6.2.2 Progress monitoring

The Contractor is required to generate a project time schedule with milestones, including all work packages, and shall be responsible for permanent monitoring of the project progress.

The progress report shall cover all essential components of the delivery and provide information on actual versus target comparison of work in progress.

6.2.3 Meeting

The Contractor shall conduct periodic meetings with its suppliers and Owner´s representative during all phases of the project which current technical, organizational and schedule issues are discussed.

6.3 SCHEDULE

The overall schedule shall start from the works commencement date and end on the completion date. Subject to an Agreement with the Owner and to obtaining all applicable permits and required insurance policies, the Contractor may perform pre construction activities to advance the schedule prior to the works commencement date.

Without derogating from requirements under the Agreement, the EPC Contractor shall comply with the following minimum requirements for project scheduling:

- The Work Breakdown Structure (WBS) shall be prepared by EPC and non-objected by SPC before starting implementing the schedule.
- The WBS shall be result orientated (completion of sub-systems such as generating unit, substation, embankment, intake structure…).
- The schedule structure shall include all activities from design (taking into account review periods for non-objection) to completion of sub-systems, including factory tests and commissioning.
- The schedule shall set out interfaces milestones for all the packages.
- The schedule shall evidence links between relevant tasks, float and critical path.
- Sub-system completion shall include deliverables such as “erection and commissioning procedures”, O&M manuals and spares.
- The schedule shall be updated monthly and issued to the Owner.
- The schedule software shall allow issuing PDF files in an easily readable arrangement (A3 format) without any manipulation required.
- The commissioning schedule shall be based on a user friendly software (MS Project or equivalent) allowing easy site update on a weekly basis.

As far as practicable, dedicated parts (such as commissioning schedule, design schedule, documentation delivery,…) shall be directly extracted and reincorporated in the overall schedule.

6.4 INTERFACE MANAGEMENT

The Contractor shall issue to the Owner's non-objection, as part of the Proposal documents, an interface management procedure, explaining and detailing with appropriate sketches, the physical interfaces between the different packages by its subcontractors and associated responsibilities.

The Contractor shall issue, once the contracts had been awarded, a document naming all the sub-Contractors, detailing the interface management procedure and specifying (among others) all the dates when any document is needed by any party involved.

All the interfaces shall be referenced by an identification number, such that it will be easy to follow up the procedure, and its progress. This document shall be updated on a regular basis, in order to be always applicable. The interface guidelines are provided in the RFP Documents (Section XI, Volume 2).

6.4.1 SITE MANAGEMENT Health and safety

6.4.1.1 General

The EPC Contractor and its Sub-Contractors shall ensure that the workplace for which it is responsible is a healthy and safe working environment. The Contractor shall provide all necessary staff, resources and materials to provide for health and safety in accordance with the conditions of the Agreement and all applicable Laws.

Without in any way limiting the generality of the foregoing, the EPC Contractor shall, in respect of all activities in connection with execution of the works:

(a) develop all appropriate measures to be taken to control dangerous goods and prevent industrial accidents;

(b) provide first aid services adequate to deal with the medical needs of the Contractor’s, subcontractor's and Owner’s personnel at all times on the site;

(c) install and develop appropriate fire protection, monitoring and prevention services;

(d) ensure that the temporary works comply with the environmental requirements and all applicable Laws;

(e) implement health and safety measures in respect of the buildings and adjacent areas, including offices, workshops, workers shelters, dining rooms and toilettes;

(f) construct and maintain facilities (if any) for water supply and sewage collection and treatment that comply with the Laws and applicable requirements;

(g) provide for the collection and disposal of industrial garbage and by-products, including used oils and hydrocarbons, that complies with the Laws and the Contractor's Environmental Monitoring and Management Plan;

(h) provide effective storm water collection and disposal systems for all work and accommodation sites, with open areas sufficiently well graded and drained to prevent ponding.

(i) The Contractor shall audit, by an independent HSE Expert the HSE Plan as approved by the Owner.

6.4.1.2 Health and Safety Plan

The Contractor shall provide a comprehensive Health and Safety Plan to be submitted to the Owner for non-objection 1 months before the Works Commencement Date.

The primary purpose of the Health and Safety Plan is to establish a process to preserve the health of all personnel and prevent any accidents that may injure personnel, damage property within the Site or delay the schedule. The Health and Safety Plan shall be based on Israeli Standards and shall follow the Israeli regulations.

The Health and Safety Plan shall include:

- guidelines to be followed by the SPC, EPC Contractor, Sub-Contractors and other contractors and their personnel working at the site;
- guidelines and safety rules to be followed by authorized visitors to the site;
- the organization structure and reporting lines in respect of health and safety involving the SPC, the EPC Contractor, Subcontractors and other contractors;
- detailed description of the responsibilities, roles, authorities and functions of the Site safety Officer and the Safety Committee;
- emergency procedures and plans for responding to health and safety emergencies;
- training requirements and implementation plan and program;
- a timetable for implementing the Health and Safety Plan;
- proposed method of implementing the Contractor's Environmental Monitoring and Management Sub-plan for the Project Staff Health Program;
- proposed reporting format and information to be provided for Monthly and Quarterly Progress Reports.

The Contractor shall report on the implementation, monitoring and performance of the plan in each Progress Report (see also 6.4.1.1 item (i)).

6.4.1.3 Safety Officer

The Contractor shall appoint a Site Safety Officer whose specific responsibilities, roles, authorities and functions shall be set out in the Health and Safety Plan.

6.4.1.4 Safety Committee

Within 60 days of the Works Commencement Date a Safety Committee shall be established with representatives of the Owner and the EPC Contractor. The Safety Committee shall review general safety policy at the Site and its specific responsibilities, roles, authorities and functions shall be set out in the Health and Safety Plan. The responsibilities of the Safety Committee shall include:

- setting the procedures for safety meetings;
- defining the requirements for safety monitoring and reporting;
- defining the role and responsibilities of all relevant health and safety personnel;
- reviewing emergency procedures for responding to a health or safety emergency;
- reviewing the implementation of the Plan, including safety education, extent of worker awareness and prominence of safety signs and reporting.

The Safety Committee shall meet quarterly or after particular circumstances at the request of the Owner or the Contractor. The members of the Safety Committee will be the Owner's Engineer, EPC-HSE Officer and the Construction manager. Other members may be invited ad hoc as needed.

6.4.1.5 Safety of Personnel

The Contractor shall ensure that safe work practices are developed and adopted by all personnel. Such safe working practices shall be developed in respect of (without limitation) safety equipment, barriers and signals for dangerous areas, noise protection, lighting, equipment management, order and tidiness, signs, fire prevention and fighting, smoking, fire extinguishers, house-keeping, heating and/or cooling devices, paint and painting, emergency procedures, instructions, electrical activities, working at heights, safe transport and lifting, forklift trucks, hoisting, welding/burning, storage and handling of gas, work inside confined spaces, work in tunnels and underground works, dangerous/flammable products, hand tools, radiographic inspections, storage and handling of radio-elements, issue of work permits, explosives, rock drillings, rock bolting, shotcreting, concrete placement, crane operations, earth moving and excavation plant and equipment, vehicle driving.

6.4.1.6 Emergency Procedures

Emergency procedures shall be prepared as part of the Health and Safety Plan and issued separately. The Contractor shall update all emergency procedures each time there is a material change to working conditions.

6.4.1.7 Emergency Contingency Plans

The Contractor shall prepare Emergency Contingency Plans relating to the safety and security of persons and the environment arising from or consequent upon impounding of:

- the upper reservoir (including filling the hydraulic circuits) and
- the lower reservoir.

The Emergency Contingency Plans shall outline responsibilities of the EPC Contractor, especially in case of identification and notification of population at risk.

The Emergency Contingency Plans shall include the following requirements for each of the elements of the works:

- emergency identification and evaluation;
- preventative actions if available;
- notification procedures and flow charts;
- communication system;
- response during periods of darkness and adverse weather;
- sources of equipment;
- stockpiling of supplies and equipment;
- emergency power supplies;
- inundation maps with predicted water levels;
- indicative filling program.

The Emergency Contingency Plans shall propose procedures suitable for each element of the works considering physical characteristics and consequential risks.

The Contractor shall submit the final Emergency Contingency Plans to the Owner for non-objection no later than 90 days prior to commencement of impounding the reservoirs.

6.4.2 Site security

6.4.2.1 General

The Contractor shall provide necessary and appropriate safeguards within the site for the protection of the works and all persons and other property related thereto, including lights and barriers, guard service, controlled access and other measures developed or required to prevent vandalism, theft and accidents.

The Contractor shall issue procedures for the security of the works and to define actions to be followed by the authorized security personnel.

6.4.2.2 Site Security Plan

The Contractor shall prepare a comprehensive Site Security Plan to be submitted for non-objection by the Owner thirty (30) days prior to the Commencement Date.

The Site Security Plan shall define the required actions to be followed by the Authorized Persons, including:

- Procedures to define actions to be followed by the Authorized Persons;
- Procedures to define actions of guard services and security personnel while carrying out their work, including the area of their authority;
- Procedures and obligations of all Authorized Persons related to working and normal living situations;
- Organization of all security personnel;
- Proposed methods of enforcement of security regulations regarding traffic, firearms possession, Site access and the Environmental Requirements as relevant;
- Communications procedures for contacting external authorities;
- Proposed Temporary Works and Permanent Works to meet the security requirements, including security fencing and lighting;
- Training requirements and proposed implementation.
- The Contractor shall report on the implementation, monitoring and performance of the plan in each Progress Report.

6.4.2.3 Access to the Site

The Contractor shall not allow the ingress or egress of personnel, equipment, vehicles and material except at points designated and controlled by the Contractor.

The Contractor shall ensure, by means of an identification procedure, that access for personnel will be limited to the specific areas necessary for the performance of their respective duties. Authorized persons shall be provided with permits to enter such specific areas.

The Contractor may require unrestricted access to be limited to approved authorized persons in some specific areas, for reasons of safety, security, cleanliness or working environment. The EPC Contractor shall include the proposed restricted or limited access areas in the Site Security Plan submitted for the SPC's non-objection who will comment on the proposals and, where necessary, advise the EPC Contractor of the authorized persons required to have access to these restricted or limited areas. The Contractor may require modifying its restricted or limited access areas from time-to-time and shall submit such proposed modifications to the Owner for non-objection.

6.4.2.4 Site Rules

In respect of the Contractor's personnel, the Contractor shall ensure that the following items and activities are not permitted within the site:

- Drugs;
- Consumption of alcoholic beverages
- Violent actions;
- Dwellings other than in designated accommodation areas;
- Gambling, political activities, sleeping while at work;
- Anti-social, discriminatory or harassing behavior;
- Attending work while under the influence of alcohol or drugs;
- Smoking in prohibited areas;
- Interfering with works and equipment of others without prior consent;
- Entering or exiting out of scheduled hours without authorization;
- Collecting money without authorization; and
- Any other activity which is illegal under the Law.

The EPC Contractor shall ensure that authorized persons and any authorized visitors to the site are advised that the above activities are not permitted within the site.

6.5 REQUIREMENTS OF TEMPORARY WORKS

6.5.1 Contractors site organizations

The main construction site will be located in the following areas:

- Area near switchyard and main access tunnel portal,
- Northern area of lower reservoir,
- Northern and southern area of upper reservoir

and the technical area according to laydown area building permit. No temporary structures and/or construction facilities will be erected beyond the building permit boundaries (designated for laydown area).

The site will be prepared by the EPC Contractor and will be fenced in order to prevent access of strangers. The site will be connected to electricity, water, gas, communication and sewage/septic tank facilities under the responsibility of the Contractor. The Contractor will also be responsible for all maintenance required. Garbage and/or construction waste will be delivered by the Contractor to an authorized disposal site only.

The site will be arranged with subunits to be prepared for the Owner and the EPC Contractor as well as the Sub-Contractors and will include: site offices, laboratories, concrete batching plant (optional), mobilization and storage facilities, penstock man-

ufacturing site, warehouse, storage facilities/yard and sufficient parking area. All access roads and parking will be paved by sub base material.

6.5.2 The Owner offices will be provided with the following

- Total area of 60 m², as follows:
  - One room will be divided in to three suitable "open spaces" and will be equipped with furniture's for three engineers (office tables, chairs and cabinets).
  - One room will be equipped with furniture for Owner manager (office table, chairs, meeting table).
  - One kitchen and two toilets (male - female)
- Combined fax and printer machine
- Telephone
- ADSL internet connection (or higher speed connection)
- Uninterruptable power supply
- Air conditioning
- Parking for three vehicles

6.5.3 Meeting Room

The Owner shall have access to use, upon prior coordination with the Contractor, the Contractor's main meeting room, for meetings on site with Owner's personnel and/or visitors.

6.5.4 Maintenance

The Owner's offices will be fully maintained by the Contractor throughout the period of construction.

The Contractor is responsible for the maintenance of temporary roads and sites.

6.5.5 Re-plant avocado trees

The main temporary works area is located in an avocado plant. The EPC Contractor shall uproot as many avocado trees as required to establish all the premises at the main temporary works area, and will re-plant avocado trees as part of the rehabilitation process.

6.6 Connection to Infrastructure for the Construction Site

6.6.1 Access to electricity power for the construction sites

Near the switchyard area a 22kV line is situated. The EPC Contractor has to request IECo for the 22kV supply.

Near the upper reservoir area a 22kV line is situated. The EPC Contractor has to request IECo for the 22kV supply.

6.6.2 Access to water supply

Near the switchyard area, within the avocado plant, a drinking water pipeline is located. The EPC Contractor has to request the local authority for access.

Near the upper reservoir, within the apple trees plant, a drinking water pipeline is located. The EPC Contractor has to request Kibbutz Manara for access to water for the upper reservoir construction area and the initial filling of the upper reservoir.

The Owner will provide a water supply connection point at the lower reservoir eastern embankment, at the blue line of the project. The EPC contractor is responsible for the water supply pipes and the convey of water inside the blue line of the lower reservoir from the connection point.

6.7 DOCUMENT DELIVERABLES

6.7.1 General

The Contractor shall prepare the Contractor work plan and shall maintain the documents and provide the Owner with paper and electronic copies in accordance the requirements of the Agreement. All documents that shall be included in the management information system shall be fully in English.

With regard to the electronic formats of the documents included in the Management Information System and specifically the Design Documents, drawing files shall be in the latest agreed AutoCAD format and reports, procedures, calculations, proposals, lists, spreadsheets and databases shall be in the latest agreed version of Microsoft Office format. The latest agreed Adobe Acrobat Reader format will be an acceptable alternative for electronic submittals of proprietary information. If other file formats are proposed, the Contractor shall obtain Agreement from the Owner and provide four (4) licensed copies of the required software.

6.7.2 Document Management and Communications

6.7.2.1 Document Management Plan

The Contractor shall use an electronic Contractor work plan for registering, recording, controlling and retrieving project Documents. The Contractor work plan shall include:

- an outline of the document and drawing numbering and system codes to be used for all documents included in the management information system;
- procedures for registering, recording, controlling and retrieving documents included in the management information system; and
- detailed lists and related schedules of submission of design documents, giving the proposed submittal sequences and dates.

The Contractor work plan shall be submitted for review to the Owner 3 months after the work commencement date.

The list of all documents issued in the frame of the project construction shall be drawn by the Contractor and updated at monthly intervals.

6.7.2.2 Communication and documents transmittal

The Contractor shall establish comprehensive communications and document transmittal protocols for all communications and transmittal of documents between the Contractor and the Owner, and the Contractor and the Sub-Contractors.

Within 3 months after work commencement date, the Contractor shall submit to the Owner for non-objection details of the proposed communications and document transmittal protocols.

6.7.2.3 Time scale and process for non-objection/comments

The Contractor shall submit design documents for non-objection during design and construction of the works as the Owner may require confirming compliance of the works with the Agreement.

The review procedure shall be in accordance with the provisions of the Agreement.

6.7.3 Documents to be provided prior to award of Agreement

Refer to section 3.4.2.

6.7.4 Documents to be provided during design development

Refer to section 3.4.1.

6.7.5 Detailed Design and construction (erection) Documents

Design documentation to be submitted to the Owner by the Contractor is defined in the relevant detailed technical specification, and shall include as applicable:

- DBM of each design report (Design Basis Memorandum) including standards used
- DCR (Design Calculation reports) including analyses of the results;
- Computer programs and other software references;
- Construction and execution drawings adequate for the expected design review and factory inspection by SPC and for further needs during operation period;
- Manufacture documents such as manufacture and welding procedures.
- Functional drawings (including single line diagrams, sequence flow charts, logic diagrams, circuit diagrams, etc.);
- Testing and Commissioning plans, procedures and manuals;
- Architectural Models;
- Model study reports;
- Technical specifications and performance curves;
- Construction and procurement schedules;
- Method statements and erection plans;
- Parts and components lists;
- Operation and maintenance manuals;
- Operating instructions and procedures.
- Any other design document required by the Owner and/or the LTA.

The design documents shall, as a minimum clearly indicate the general arrangement and give principal dimensions, show all details, features and finishes and provide sufficient notes to fully describe the equipment or portion of the power plant, including all relevant operating and maintenance criteria.

6.7.6 Environmental Monitoring and Management Plan

Refer to § 3.5 Environmental and social requirement.

6.7.7 Quality Assurance Plan

The Contractor shall appoint a Quality Assurance manager, experienced, fluent in English, etc.

The Contractor shall prepare the quality assurance plan to define the quality system for the works to ensure and demonstrate that the works conform to the requirements specified in the Agreement.

The quality assurance plan shall identify the quality practices and resources relevant to the works and shall be submitted to the Owner in accordance with the provisions of the Agreement. It shall comply with the requirements of ISO 9001-2000: Quality Systems.

The Quality Assurance Plan shall include all activities associated with the design, construction, management, administration, testing and commissioning of the works. The Contractor shall indicate in the Quality Assurance Plan which quality procedure is applicable to each of the listed activities and work packages. The Quality Assurance Plan shall include the following:

i. The Contractor’s proposed quality program which shall meet the requirements of ISO 9001: 2000 and shall specifically address the following:

a. Which quality procedures are applicable to each work package and activity.

b. Inspection and Test Plan(s), together with installation checklists and commissioning checklists, as appropriate, and the Contractor’s proposed witness and hold points and the test records and certificates to be provided.

c. Non-compliance procedures which ensure that work not complying with specified requirements is reported to the Owner and corrective action proposed.

ii. Pro-forma examples of the following documents:

- Inspection and Test Plan
- Installation Check list
- Clearance Procedures and Pre-energizing Checklist
- Test Records, Test Schedules and Test Certificates
- Non-compliance procedures

iii. The procedures to be adopted in the management of quality records, including:

- Document control system,
- their organization, collation, and indexing, and

- their safe storage by the Contractor in a readily retrievable form for access if required by the Owner

The Quality Assurance Plan shall, as a minimum, address the following matters:

i. Project Management

- Development of organization charts and other information and procedures for monitoring and auditing Sub-Contractor's quality assurance programs.
- Establishment of the project organization and quality systems, including the division and co-ordination of responsibilities for the Contractor's multi-divisional organization and Sub-Contractor's quality assurance programs;
- Identification of key quality related activities under the Agreement and their progress through to the handing over date;
- Preparation of a list of key personnel to meet the requirements of ISO 9001: 2000, including those with responsibilities and authority to implement the quality assurance plan;
- Co-ordination and control of project design, engineering, procurement, construction and commissioning activities;
- Establishment of methods of communication between suppliers and manufacturers and the Contractor; and
- Administration of the Agreement.

ii. Project Controls

- Identification of key quality related activities under the Agreement and their progress through to the handing over date.
- Development of a system to control the submission and response process of documentation submitted for the non-objection of the Owner for the duration of the Agreement.
- Development and implementation of a process to monitor and report on the Program;
- Preparation, co-ordination, and implementation of detailed schedules;
- Documentation and evaluation of changes in scope, cost, schedule and other Agreement terms and conditions; and
- Manpower planning, reporting and performance

iii. Quality Assurance and Quality Control Services

- Performance of supplier surveillance activities;
- Verification that the quality assurance plan adequately satisfies the requirements of the Agreement and is effectively implemented and maintained through quality system audits, surveillance and management reviews;
- Performance of internal quality system audits;
- Participation in the evaluation of vendors' and Sub-Contractors' quality system submittals as applicable based on their scope of supply;

- Provision of a quality review organization and services directed by the Contractor's quality assurance manager; and
- Use of QA certified laboratories for sampling and testing of materials.

iv. Engineering and Design Services

- Design surveillance of the suppliers including evaluation and approval of technical documents;
- Identification of key quality related activities under the Agreement and their progress through to the handing over date;
- Preparation of designs, drawings, specifications and reports for the works;
- Verification that manufacturer and supplier develop and implement quality inspection and test plans as required;
- Ensure that purchase orders to manufacturers and suppliers specify compliance with applicable standards and specifications in accordance with the Agreement;
- Disposition of field change requests, field change notices and nonconformity reports; and
- Review of Contractor's design submissions by the Owner.

v. Procurement/Purchasing

- Procurement/purchasing activities shall comply with ISO 9001: 2000.

vi. Manufacturing Services

- Identification of quality related activities under the Agreement and mechanisms for tracking progress of work through to the handing over date;
- Development and implementation of manufacturing organization and procedures, including communication with vendors and Sub-Contractors;
- Manufacturing planning. Implementation of manufacturing program;
- Administration and co-ordination of manufacturing Sub-Contractors;
- Supervision, performance and inspection of work;
- Control of non-compliances;
- Control of material and test equipment, and the inspection and test status;
- Handling, packaging and preservation; and
- Manufacturing testing.

vii. Construction Services

- Identification of quality related activities under the Agreement and mechanisms for tracking progress of work through to the handing over date;
- Preparation of standard and project-specific work practices;

- Development and implementation of construction organization and procedures, including communications with Owner, vendors and Sub-Contractors;
- Construction planning;
- Administration and co-ordination of construction subcontracts;
- Supervision, performance, and inspection of site construction work;
- Field purchasing and material control;
- Construction inspection and testing;
- Issuing field engineering changes that meet quality standards and Owners Requirements;
- Implementing corrective actions.

viii. Pre-commissioning/Commissioning Services

- Identification of key quality related activities under the Agreement and track progress through completion;
- Development and implementation of pre-commissioning/ commissioning instructions for testing and commissioning of the power plant;
- Review instructions prepared by Sub-Contractors. Training of the power plant operators. preparation of start-up schedule;
- Management of Sub-Contractors and vendors associated with pre-commissioning and commissioning materials and activities;
- Collection and collation of all inspection and test plans and certification of their satisfactory completion for handover to the Owner prior to issuance of the handing over certificate in respect of a section or the works, as the case may be.

6.7.8 Operation and Maintenance Manuals

The Contractor shall prepare and provide the Owner with the provisional as-built plans and the final as-built plans, in each case – in accordance with the provisions of the Agreement.

The as-built plans which will be prepared by the Contractor shall describe and show the as-built arrangement, condition or status of the features, equipment, plant, systems and facilities of the works at the completion of the power plant.

The Contractor shall prepare and provide the Owner with the provisional O&M manuals and the final O&M manuals, in each case – in accordance with the provisions of the Agreement. The contents of O&M manuals shall be organized as follows:

- Table of contents
- Introduction

  The introduction must contain:
  - A brief general description of the equipment.

- A brief description of technical terms used.

- Detailed description: Included herein will be a complete detailed description of the equipment, its subassemblies, components and accessories. A detailed list of clearance tolerances, temperatures, settings system data, etc., is required.
- Principles of operation: A brief summary is required of the technical basis for operation of the system or equipment.
- Operating instructions: The instructions shall be clear, concise and preferably in steps. The information shall be presented in such a manner that the contents of this section can be used to instruct untrained personnel in the operation of the system or any equipment. For clarity of presentation, careful consideration shall be given to the use of charts, tables, and operating data in this section.
- Testing and adjustment: The complete procedure of testing and adjusting the system or any parts during operation, after overhaul, or during recommended periodic checks must be covered. For all important items of equipment, test programs in tabular form shall be included.
- Drawings: All layout drawings, assemblies and sections, schematic drawings, detailed control and wiring diagrams, program documentation, flow sheet, piping diagrams, etc. As many drawings as necessary shall be included from those prepared under the Agreement to make the manuals complete.
- Manufacturers' descriptive technical literature.
- Detailed photo/video-documentation of the manufacturing and erection process of all components.
- Maintenance instruction: This section will be divided in two subsections:
  - Preventive maintenance (time based and condition based), which will indicate the inspections required, the inspection procedure, the routine cleaning and lubricating procedures, the routine safety checks, the maintenance actions required and associated procedures.
  - Trouble shooting guide: For repair and adjustment, it will describe the inspection, removal and replacement of parts for which spares are available, electrical or mechanical circuit tracing, repair, and adjustment procedures.
- The Contractor shall set out in these instructions the intervals (expressed in hours of operation or maximal period length, whichever comes first) or criteria of exchange of equipment to be replaced in the course of operation. The minimal periods between major repair/overhauling of the units shall be not less than 20 years.

The "**In Service Inspection Program"** shall define the elements to be inspected while the equipment is under operation and the periodicity of inspections.

The **"Set Point List"** shall furnish data on all the elements making up an instrumentation line in a system. For each element, columns in the list provide module identification number, designation of set point, measuring range, unit and set point.

The **"Computer I/O Summary List"** shall give a comprehensive view of the signals used and supplied by the data processing computer, with their related features (reference, scale, scanning period, threshold, etc.). This summary shall essentially be

a compilation on an adequate form of the related information given in the various System Manuals.

The "**Training Program"** shall define the contents of the training activities.

The "**Spare Parts list**" shall list the Spare Parts provided by the Contractor.

The "**Tools list**" shall list the Tools parts provided by the Contractor.

6.7.9 Operating instructions and procedures

The Contractor shall prepare and submit draft Operating Instructions and Procedures for the works before commissioning and training sessions.

The procedures will be further made final under Owner's responsibility (directly or through its O&M Contractor) and with the Contractor's contribution as may be required.

6.7.10 Testing and Commissioning Procedures

The Contractor shall prepare and submit comprehensive testing and Commissioning procedures for all plant, equipment, systems and facilities for each section of the power plant and which will demonstrate that the works will perform as specified.

The testing and commissioning plans and procedures shall detail the following:

- Method of testing;
- Equipment to be used for testing;
- Parameters or guarantees to be established;
- Pass / Fail criteria
- Sequence of tests to be performed.

Testing and Commissioning procedures shall be submitted to the Owner for non-objection, as follows:

Action by Contractor	Time Required
Submit draft testing and Commissioning procedures for the Owner's non-objection	150 days prior to commencement of preliminary tests of each sub-system.
Submit final testing and Commissioning procedures	90 days prior to commencement of preliminary tests of each sub-system.

6.7.11 Testing and Commissioning Results and Reports

Comprehensive site testing and Commissioning test reports shall be prepared for all plant, equipment, systems and facilities. Copies of testing and Commissioning reports shall be submitted to the Owner for non-objection, as follows:

Action by Contractor	Time Required
Submit draft testing and Commissioning reports for the Owner's non-objection	2 weeks after completion of tests of each sub-system.
Submit final testing and Commissioning reports	pre-requisite to the issue of applicable certificate in accordance with the provisions of the Agreement

The results should be recorded in the system immediately after accepted.

6.7.12 Other Documents

6.7.12.1 Progress reports

The Contractor shall monitor the progress of its activities and those of its Sub-Contractors in carrying out the works and shall report this progress to the Owner in progress reports as set out below.

The Contractor shall prepare and submit progress reports to the Owner as follows:

- Each month the Contractor shall submit, by the tenth (10) day of the following month, a report describing the activities and progress over the subject month ("Monthly Progress Report").
- Each quarter the Contractor shall submit, by the fifteenth (15) day of the month following the end of the reporting period, a report describing project development over the preceding three months, including a risk register ("Quarterly Progress Report").

As applicable, reporting shall continue until the Contractor has completed the works, including completion of all outstanding work stated in the Initial Defects List, if applicable. The format and content of the progress reports shall be modified to reflect the reduced reporting requirements following issuance of the Handing Over Certificate.

The reports will be prepared also during Preliminary Works, if there will be such works.

6.7.12.2 Progress Meetings

Progress meetings of the works shall be held monthly and within five days after the "due date" for receipt of the Monthly Progress Report. The progress meetings shall be attended by representatives of the Owner and the Contractor and shall be held at the Contractor's site office or such other venue as is agreed between the Parties.

6.7.12.3 Project completion report

The Contractor shall submit a Project Completion Report prior to the completion of the works as one of the prerequisites to the issue of the Taking Over Certificate.

The Project Completion Report shall report on the design and construction of the works and shall include (but not limited to) the following information:

- an introduction;
- a project description;
- a summary overall report on the design and construction of the works, including consideration of management of interfaces, completion times, Contractor's Environmental Monitoring and Management Plan and other relevant matters, including external parties and issues;
- a summary report on the implementation and outcome of the Contractor's Environmental Monitoring and Management Plan;
- for each feature of the works, a summary report of the investigation, design and construction, based on information provided at the bidding stage, subsequent survey and investigations, design phase reports, construction phase reports, and with reference to attached as built plans where required;
- appendices of a sufficient number of project and as-built drawings to adequately describe the completed works.
- Lessons to be learned
- Quality report to conclude all quality issues during the project.

7 TESTS ON COMPLETION AND OWNERS TAKING OVER

7.1 TESTING AND COMMISSIONING PROCEDURES

7.1.1 Inspections and tests at factory

All equipment, materials and components shall be, depending on the case, subject to type, sample and routine tests and inspection while in process of and upon completion of manufacture. For each piece of material, plant or component, the inspection and tests shall consist of:

- The inspection and tests required by the applicable standards;
- The relevant inspection and tests as specified in the Agreement;

Factory Tests shall also include:

- Tests on materials, particularly of main plant components;
- Non-destructive tests of welds and welded components;
- Hydrostatic pressure tests as appropriate;
- Voltage withstand tests as appropriate;
- Component and assembly tests, including dimensional and clearance checks on main plant and equipment;
- Test on individual control system, including hardware integration tests, functional performance tests, and integrated system reliability tests.

Test results shall be recorded for the factory tests conducted on the plant, equipment, systems and facilities. The test results shall be in the form of test certificates or test reports witnessed by the EPC and the Owner´s engineer.

7.1.2 Inspections and tests on site

During erection and commissioning, the Contractor shall perform all inspection checks and tests in the presence of the Owner and/or the Owner's engineer, at suitable intervals in order to prove the orderly execution of the works in accordance with the Agreement.

Upon termination of erection of a part or section of the permanent equipment which can operate as an independent unit, tests on plant, equipment, systems and facilities at site shall be carried out by the Contractor. The tests on completion shall be carried out in the following sequence:

(i) Preliminary tests which are inspections and tests carried out under no load conditions prior to rotation of, energizing the main equipment at normal voltage, or admission of air, water or oil at normal pressures to the main or auxiliary plant under test.

(ii) Commissioning tests, which are tests to progressively prove the correct operation and performance of each equipment and systems, they shall include the specified operational tests to demonstrate that the power plant or section of works can

be operated safely under all operating conditions. In particular, all the mode changes times as per IEA criteria shall be tested.

(iii) Acceptance tests, which are those tests intended to determine the performance of the power plant with respect to the operational parameters specified in the provisional license. Acceptance tests include the trial run operation (or test service period as per IEC 60805) to prove the correct and stable operation of the entire power plant. Detailed testing sequence described in the Appendix [1] “Acceptance Test Procedures” of Israel Electric Corporation LTD. (IECo) according Volume 2 - General E&M Technical Specifications.

The Contractor shall be responsible for testing and operation (including care and custody) of all plant, equipment, systems and facilities up to the issue of handing over certificate.

Before testing, the Contractor shall submit a notice containing full information about the test procedure with detailed tables or graphs of the latest edition of the characteristic values of the equipment to be tested and of the test equipment. After the tests, comprehensive testing and commissioning, reports shall be prepared for all plant equipment, systems and facilities.

Prior to issuing the handing over certificate, the Contractor shall, at the reasonable request of the Owner, open-up or dismantle any part of the works for inspection by the Owner. Such requests for inspection by the Owner shall be accompanied by objective substantiation of the reasons for requesting the inspection prior to issuing, the handing over certificate for the related section of the works.

Dispute, if any, regarding the need of such inspection shall be addressed per the terms and conditions of the Agreement. The dispute resolution mechanism is stipulated in the Agreement.

7.1.3 Operators counterpart staff during testing and commissioning

The Owner at its sole and independent discretion, will engage an Operator to operate and maintain the power plant.

Nominated personnel of the Operator (“Operator’s Counterpart Staff”) will attend commissioning as counterparts for witness and training purposes. The Contractor shall include the Operator’s Counterpart Staff in the Contractor's commissioning teams responsible for all commissioning, testing, start-up and trial operation of plant and the commissioning and testing of each section and the whole of the works.

During commissioning, the Operator’s Counterpart Staff shall be allowed to observe the activities associated with commissioning and testing. The participation of the Operator’s Counterpart Staff in the Contractor’s commissioning teams shall be arranged to ensure that the skills, knowledge and documentation acquired by the operator’s counterpart staff will be sufficiently focused and targeted to prepare them for the task of operating the power plant. The Operator’s Counterpart Staff will take an active part in commissioning at the Contractor’s entire responsibility.

Expatriates and local staff among the operator's counterpart staff will be fluent in English, qualified and experienced in their intended roles.

8 OPERATION AND MAINTENANCE

8.1 GENERAL

8.1.1 Contract Agreement

The Owner will engage an Operator to operate and maintain the power plant.

8.1.2 Power purchase agreement

The operating and maintenance conditions and requirements of the Manara Pump Storage Plant are defined in the “Agreement for the Purchase of Available Capacity and Energy with Full Dynamic and Design Benefits from a Pumped – Storage Hydro Electricity Facility” (PPA) between Israel Electric Corp. Ltd (IECo) and Ellomay, and in the IEA Standards ("Amot Mida").

8.2 SCOPE OF SUPPLY

The detailed Scope of Work and requirements are defined in the O&M Specifications and in the “O&M Agreement” and its exhibits.

8.2.1 Activities

The Contractor shall provide the O&M Contractor with O&M manuals. The Operator is to establish and maintain an O&M program and management procedures which underline permanent improvements to increase and optimize the availability, reliability, lifetime of the power plant, and to minimize the unscheduled and forced outages, wear and tear.

The Services shall be performed according the Power Purchase Agreement (PPA), "Amot Mida", applicable laws and regulations, Israeli standards and recognized international standards for operation and maintenance of the Plant. The Operator shall operate the Plant in close cooperation with the Grid manager, the Owner, applicable regulators, authorities and relevant parties.

8.2.2 Duration

The agreement period for the O&M services is defined in the O&M Agreement.

The O&M Agreement covers the following periods:

- Pre-Mobilization Period

  The Operator shall participate in the review of the EPC design with focus on operation and maintenance of the plant and its maintainability.

- Mobilization Period

  The recruitment and training of operation and maintenance staff will be commenced. The staff training shall start during the main installation works of the

electro mechanical and hydro mechanical equipment. During the main installation works the operation and maintenance staff shall be part of the site supervision and shall participate in all activities during commissioning and taking over of the plant as further elaborated in the O&M Specification and O&M Agreement.

The Operator shall develop all O&M management procedures and routines for the daily work. The O&M team structure will be established.

- Operation and Maintenance Period

  Pursuant to Taking-Over of the Plant by the Owner the Plant shall be operated and maintained in accordance with the requirements and for a period as shall be specified in the O&M Agreement.

- Transfer Period

  During the Transfer Period the Operator shall provide all relevant information to the Owner such as maintenance history, operation and maintenance manuals, operation experience, drawings, reports, spare parts etc. to allow a transfer of the Plant to the Owner. The Owner´s staff or a personnel designated by the Owner or any one on its behalf or the staff of a replacing entity for the performance of the Services as designated by the Owner will be trained and instructed by the operator. For evaluation of the performance of the plant a performance test will take place together with the owner and technical expert and more fully elaborated in the O&M Specification.

8.2.3 Infrastructure

After Taking Over Date, the Operator shall provide and maintain all relevant infrastructure facilities for proper operation and maintenance, including:

- Accommodation for O&M personnel
- Site transport facilities
- Temporary facilities, such as office containers, storage containers or closed areas within the new power plant
- Office equipment
- Overall security services
- Electricity, water supply, gas, waste disposal and telecom connection services of the facility
- Tools, spare parts and consumables
- All other relevant equipment and services necessary for the O&M services

8.2.4 Plant operation

The power plant shall be operated according to the requirements issued by the power purchase agreement, "Amot Mida", the national authorities, applicable regulation, the instructions of the Grid manager and rules of recognized operation practices, all as stipulated in the O&M Agreement.

It is guaranteed by the System Manager, that a maximum 20% of the monthly power generation will be with < 55% of maximum installed capacity and that the upper reservoir is restored to FSL at least every 10 days. Further it is pointed out, that the operation trough central frequency load control is enabled.

It is the intention of the Owner to operate the PSP Manara, 24 hours and 7 days a week over the whole year for the operation period of 20 years. The operating staff shall monitor and control the plant for this period autonomously.

8.2.5 Plant maintenance

Subject to the Agreement , the PPA and the Standards, the Operator shall develop, implement and maintain a maintenance program to ensure a high level of performance. For that purpose, the Operator shall establish management policy, procedures and working tools in light of the instructions and recommendations of the O&M manuals of the Plant components and systems.

These maintenance shall consider the “roll forward” availability as defined in paragraph 5.6.1.1. Also, it is pointed out, that repairs of malfunctions resolved in < 24 h are much more favourable, than longer lasting ones, as stated in the respective standard.

8.2.6 Spare parts, special tools and maintenance equipment

The EPC Contractor shall provide as part of the EPC Contract Initial Spare Parts, special tools and consumables as starting package for civil, EM and HM.

After taking-over of the plant and start of commercial operation the Operator shall provide any other spare parts, consumables, tools, maintenance equipment which will not be part of EPC Contract but are necessary to perform the O&M services (i.e O&M Spare Parts) all as specified in the O&M Agreement.

The storage and procurement management of these parts shall be in scope of the Operator.