GUIDELINES FOR PREPARATION OF AGREEMENT FOR PRESSURIZED MICRO IRRIGATION SYSTEM (PMIS) PROJECTS.

विषय:— विषयांतर्गत परियोजनाओं के निविदा प्रप्त में दबाव युक्त सिंचाई प्रणाली की रखरखाव निर्देशन (OPERATION AND MAINTENANCE REQUIREMENTS FOR PRESSURIZED MICRO IRRIGATION SYSTEM (PMIS)) अनुबंध का भाग बनाने हेतु संलग्न है। आगामी निविदा प्रप्त में यह कार्यवाही करना सुनिश्चित करें।

सहपत्र— उपरोक्तानुसार।

पुष्कर कर्मांक 3441200/35/माइक्रो एरीयेशन/2016

प्रतिशिष्ट,
1. बेव मैनेजर, डाटा सेंटर पाइप्कू कोलार रेस्ट हाउस के पीछे भोपाल की ओर विस्तार
 बेवसाइट पर अपलोड करने वाले।

सहपत्र—उपरोक्तानुसार।

(एमोजी0यौबे)
गुरु अभियंता,
जल संसाधन विभाग, भोपाल

भोपाल, दिनांक 12/12/2016
OPERATION AND MAINTENANCE REQUIREMENTS FOR PRESSURIZED MICRO IRRIGATION SYSTEM (PMIS)

Government of Madhya Pradesh
Water Resources Department
December 2016
1. Objectives of Operation and Maintenance

The objective of an efficient operation and maintenance of pressurized irrigation system is to provide irrigation water as per designed quality and quantity, with adequate pressure at designated location and time at competitive cost on a sustainable basis. Operation refers to timely and daily operation of the components of pressurized irrigation system such as Pumping system (pumps/motors /VFD), Rising mains/ gravity mains, distribution system and balancing reservoirs/distribution chamber. Maintenance is defined as the act of keeping the structures, plants, machinery, equipment, other facilities and ancillary requirements like access roads, buildings etc. in an optimum working order. Maintenance includes replacements, correction of defects, preventive /routine maintenance and also breakdown maintenance.

2. Preparation of O&M Plan

A plan has to be prepared for operation and maintenance by the contractor based on make and type of equipment installed in the project and as per manufacturers recommendations and submitted to the Engineer in charge for approval at least six months prior to intended date of completion of the contract. The start of services for operation and maintenance will commence from the date of entire completion of the contract. In case of DBO contracts, the partial completion /commissioning and O&M will be the part of construction contract except for electricity charges. The O&M Manual shall be approved by the Department at least three months prior to the commencement of services.

3. Scope of services

The scope of work for construction includes, trial run and rectification of defects of the scheme as a whole and its individual component as well. Under this trial run period of 30 days continuously for 24 hours after the completion of works in all respects, the contractor has to run the scheme as a whole and will have to prove performance of each component individually as well as severally and that of whole scheme as per the standards laid down in contract. After completion of 30 days trial run the completion certificate shall be issued by the Engineer in charge. After which the scheme shall be deemed to be under O&M period. After operation and maintenance for 5 years the same shall be handed over to the Department.

During this period (5 years) the contractor shall have to appoint necessary staff for running and maintenance of scheme. The candidature of the staff being engaged by the contractor shall have to be as per O&M Manual. During this period, the staff engaged for running and maintenance of scheme will be paid by the contractor as per the wages rules. All the responsibilities of employees regarding safety/ insurance etc. shall be of the contractor.

The contractor can outsource/sublet the part or whole O&M work with the approval of Department but with his liability to the Contract intact with the Department.

During the last year i.e. 120 Days approx. of O&M, the Engineer-in-Charge will appoint staff or another O&M Contractor to get hands on training to run and maintain the scheme. Contractor and his staff will arrange training for the staff to the satisfaction of the Engineer Incharge. The O&M
contract can be extended to further 5 years with 6% annual escalation on fifth year price of original Contract.

The contractor will bring into the notice of the Engineer in charge all repairs and maintenance works done and will generate and submit monthly reports on each important parameter being monitored and an alarm enunciated during the days. The contractor shall arrange for the training of departmental staff as nominated by the Engineer in charge to monitor during the O&M period up to the satisfaction of Engineer in charge.

The contractor shall have to arrange and provide for watch and ward, security against theft, sabotage and upkeep of premises of the plant and pipe network during trial run period and O&M period. He will maintain/replace the furniture/equipment etc. if damaged during this period.

1. Approach Channel/Sluice: The contractor will provide the staff to run, maintain and keep records. The Contractor will remove any slide of slope or rock fall obstructing the flow in the approach channel, he shall keep the designed section always clear at the end of dry season i.e. May and June.

2. Pump House: The contractor will provide necessary staff to run and maintain the pumps and motors and other ancillary devices installed in the pump house. The electricity charges will be borne by the Department.

3. Distribution Reservoirs and Overhead Tanks: The contractor will provide necessary staff for watch and ward and maintenance of break pressure tanks/Distribution Chamber(DC) and all overhead tanks under this project and will upkeep the premises of the tanks to the satisfaction of the Engineer in Charge. The contractor's staff will maintain the digital record of water level in tanks and stock of inventory if any at these tanks and communication to Control Room and department portal.

4. Rising/ Gravity Mains: The contractor will have to arrange and provide for regular surveillance of rising/gravity feeder mains from Break Pressure Tanks/Distribution Chamber to the distribution network and will have to arrange for any repairs and maintenance during O&M period. All necessary T&P, consumables, pipes etc. will be provided by the contractor at his own cost and expenses.

5. Distribution Network: All the pipes, valves, nozzles and OMS (outlet management system) should be run and maintained by the contractor. List of inventory is to be prepared by the contractor for record. The Contractor shall provide complete data base of end user farmers along with AADHAR and mobile numbers for informing the status of services and creating a data base matrix for the cycle of project. Contractor shall be responsible for creating a project wise Mobile Application for the users and service providers and linking it to the department portal.

6. Electrical Substations and Electric Supply Line: The contractor will provide necessary staff and arrange for the maintenance/repairs/replacement of electrical substations and systems developed/ constructed under this contract. All expenses to operate and maintain shall be borne by the contractor, except the electricity charges.

7. SCADA, Communication and Instrumentation: The contractor shall ensure that all the components are functional and their availability is 100% for which he will provide necessary experts, Engineers and staff and arrange for the maintenance/
repairs/replacement of systems developed as per the vendors' recommendations. All expenses to operate and maintain shall be borne by the contractor.

8. Ancillary Works: All ancillary works constructed or provided under the work Contract like availability of access road and bridge round the year in good condition, all buildings, parking areas, fencing, land shaping, gardens, vehicles shall be kept in good shape to provide support to Department as well as to the staff of contractor engaged in O&M work.

9. Insurance: All the work as per condition (Above ground/underground) shall be insured against theft, fire and other eventualities. All the service staff shall be insured including third party insurance.

10. The Grievance Redressal System: This will be in place and a call center will be established in the Control Room for the purpose. The record of break down/complaints and their redressal/compliance will be electronically logged and will be made available to MPWRD portal. Aggrieved party can make an appeal to Engineer in Charge.

Handing-over after O&M period: Before handing over the components to the department all the structures and the Electrical & Mechanical equipment and distribution network must be in good running condition. It will be the responsibility of the contractor to show that all stipulated Service Level Standards have been fulfilled and are up to the mark on the date of handing over the works to the Department. The Department will not take any responsibility of the employees engaged by the contractor to run the scheme during trial run and O&M period. The scheme and all its components individually, shall be handed over to the Department in a very good maintained condition. If the contract is expiring before March 31st, then it can be extended up to 31st March by the department on same terms and conditions to facilitate smooth Rabi irrigation. The final evaluation of the project should be carried out by an independent engineer appointed by the department. The fee of independent engineer will be borne by the contractor and the department equally.

4. SERVICE LEVEL BENCHMARKS DURING OPERATION & MAINTENANCE

1. General: The contractor shall be responsible to maintain service level standards during the 5 years of operation and maintenance period and these standards shall be effective on the date of handing over the project to the Department.

2. Service Level Standards: The following standards shall be maintained by the contractor:-

a. Duty and pressure at field: Water for irrigation should be ensured at the outlet of 1 ha chak with exit head of 20m and duty of 0.45 lit/sec/ha during demand. This is the key deliverable and prime service level benchmark required in the contract and through the O & M period.

b. Pump and motor efficiency: The pump and motor efficiency should be maintained as provided in O&M manual.

In case of not meeting the standard, the penalty shall be imposed as per Contract.
Annexure I - General Guidelines

Management, Operation and Maintenance (MOM)

1. General Responsibilities

Management, Operation and Maintenance (MOM) of the Project will be done on a joint basis, with clear roles for management, as well as defined financial and staffing responsibilities, for each respective entity. Joint management of Project involves a newly constituted tripartite institution comprising the MPWRD, federated WUAs and the DBO Contractor.

The MPWRD means officer designated by MPWRD or any person or agency nominated by the Chief Engineer MPWRD to work on behalf of the department.

The proposed structure for the MOM of the Project is as under:

(i) The overall project would be under Chief Engineer, who would have a small support staff comprising of project management unit. The dam and reservoir, would remain under the authority of Madhya Pradesh Government.

(ii) The scope for the contractor will consider not only design and construction costs, but also performance requirements, so that it as a single entity, will be responsible and accountable for MOM. The service portion of their contract will establish the contractor's specific responsibilities to meet all present and future requirements for delivering appropriate water quantities at flows and pressures determined by the MPWRD-approved detailed design. Coordination between the contractor and the WUAs for developing the planned irrigation schedule, based on the availability of surface water supplies, shall be monitored by the Engineer in Charge every year.

(iii) The day-to-day management of the distribution and delivery of irrigation water, comprising mainly the operation of the pump stations and pipeline distribution network, is assigned to the Contractor. He shall provide for over all irrigation management services and maintenance of physical assets covering the whole scheme.

(iv) Each WUA will be responsible for monitoring the pipelines and hydrants in their respective area, including record-keeping and water planning.

(v) A stakeholder committee (ICC) will be established by the Chief Engineer to liaise and coordinate between the different stakeholders, the committee would be chaired by the Superintending Engineer MPWRD. The committee will meet at least once in a quarter. The members of committee headed by SE will include 5-7 members from WUA, two from contractor and two officers from water resources supervising distribution system. The above approach will ensure that all facilities (built to the MPWRD's specifications) will be compatible, coordinated and cost-effectively maintained to assure long-term reliability, optimized energy use and meet future agricultural goals.

2. Approach to the Seasonal Water Planning Process

In general, the key to sustainable MOM of the Project - meaning efficient, cost-effective, and meeting the needs of agricultural and non-agricultural water users - is developing the proper combination of physical infrastructure, communications, information management, and cost recovery. To achieve this principal objective, the management institutions at all levels of the system must: (i) implement an Annual Operation Plan - MPWRD and DBO Contractor for the main pump stations and the WUA for the irrigation systems; (ii) ensure equitable and timely irrigation supplies insufficient quantities and in accordance with water user's requirement and schedule; and (iii) manage the distribution of irrigated water to farmers in accordance with hydrological and climatic conditions like rainfall and water shortage. A critical feature of future operations in the Project will be a comprehensive water planning process that occurs at the beginning of every irrigation season. This planning process will result in a water management plan that
governs all aspects of water deliveries, scheduled maintenance, and cost recovery (payment amounts and fee collection).

At a suitable time prior to the start of the main pump station, the irrespective WUA’s, will submit a cropping and irrigation plan for the upcoming season. At the same time, the MPWRD will prepare a plan of forecasted water availability and tentative delivery schedule, taking into account required maintenance periods and water use during previous years. It will be the role of the contractor, to reconcile the cropping and irrigation plans with the projected operation of the irrigation system. It is anticipated that there may be several iterations in the planning process involving extensive dialogue between WUAs/farmers throughout the entire command area and the MPWRD, facilitated and led by the contractor.

This joint water management plan will also be updated and adjusted as necessary during year to account for current conditions. The plan will serve as the basis for charging farmers/WUAs for irrigation water service. However, the crucial point in terms of the MOM of the Project is that there will be robust planning process put in place that provides an administrative framework for day-to-day and hour-to-hour distribution and delivery of water.

It is envisioned that the assigned staff in the control center at the main pump station(s) will control the distribution of irrigation water in the pipeline distribution system on the basis of an arranged demand schedule. On a daily basis, the contractor will arrange for delivery of water to each primary control at 300 ha where it will be measured and recorded on a real-time basis. The pipelines themselves are operated automatically, supplied by gravity flow from the DCS. Below the primary control water will be distributed through secondary control at 30 ha (Hydrants). The distribution at 3 ha tertiary points will be the responsibility of the WUGs in each WUA acting on behalf of its member-farmers. The essential point is that the irrigation system must function in terms of each level whose primary responsibility is to provide an agreed-upon service to its next lower level.

The service portion of the agreement will require the contractor to achieve water delivery performance standards at field level.

3. Daily Operations Procedures

The fundamental requirements of an effective daily operations procedure of the Project are as follows:

(i) Planned water delivery orders are processed daily at a central location (i.e., at the control room of each main pump station, where flow rates in the pipeline are monitored in near real-time)

(ii) Required flow rates are summed for each sub-command area system, to make certain that the capacities will not be exceeded.

(iii) Generally, field operators should be mobile and be able to quickly travel throughout their zone of responsibility

(iv) Daily, operators within the main pump stations are told what flow rates must be delivered at all delivery points within their zone of responsibility. On a weekly or 10-day basis, they check the delivered volume against the planned volume.

(v) The delivery schedule carried out by the staff at the pump stations properly reflects the downstream needs and requests (i.e., it is based on feedback from WUAs).

(vi) The official seasonal planning schedule of deliveries for each main pump station is regularly adjusted, based on observations of actual conditions and forecasts of irrigation demand.

(vii) Major changes in the flow rate in the main pipelines supplying the administrative levels of the system are made several times per day.
(viii) Changes in flow rate at village block level may occur multiple times per day, based on downstream water orders.

4. Water User Associations

WUAs must enjoy the trust of farmers in order to effectively carry out normal MOM of the water delivery facilities under their responsibility, as well as helping MPWRD in recording of irrigated areas and collecting irrigation revenue and energy charges. For this purpose each WUA will monitor water deliveries throughout the season according to the planned irrigation schedule. WUA shall be governed by Participatory Irrigation Management Act 1999, Madhya Pradesh.

The WUAs in the Project will be responsible for: (i) monitoring the status of the farm irrigation and drainage infrastructure; (ii) planning maintenance activities in their area of responsibility; (iii) determining the area to be cropped each season for determination of water requirements; (iv) monitoring water use according to the agreed-upon delivery schedule; and, (v) ensuring equitable water delivery service among farmers.

5. Role and responsibility of Contractor

A written manual will be prepared by the contractor during project implementation for each electrical and mechanical component (or electrical and mechanical sub-system, as appropriate) and that of the constructed distribution network that contains the following sections:

(i) functional description
(ii) maintenance inspections to be carried out
(iii) maintenance intervals
(iv) diagnostic and trouble-shooting procedures
(v) technical specifications

Generally this information will be provided by the manufacturer or supplier of the equipment; however, the contractor will prepare these MOM manuals to the requirements of the MPWRD.

Appropriate steps will be taken to transfer knowledge and technical skills to MPWRD staff in the project and avoid the potential pitfalls associated with steep learning curves of such a complex technology. This will require substantial and sustained efforts in terms of training and capacity building. This will help ensure the MOM of the pump stations, to the norms of international standards. In addition, improvement of scheme-level MOM practices will contribute to reduced running costs and better service for water users.

In the interest of proper and efficient maintenance, it is imperative for the contractor to arrange training program and refresher courses. Because of the constant changing maintenance techniques, group discussions and lectures will also be required to improve the efficiency of maintenance staff and widen their knowledge.

a. General Maintenance

The operation service contract will contain specifications addressing maintenance, repair and replacement of project facilities. In addition to ordinary maintenance and upkeep of the pump stations and pipelines, the contractor will also be responsible for major maintenance and repairs.

The MPWRD will conduct unscheduled inspections, periodic maintenance inspections and full scale annual inspections as outlined in the following sections. The contract agreement will require that the facilities be returned to the MPWRD in good condition at the end of the defined operating period (i.e., 5 years). The method for determining the condition level of the structures and equipment, as well as the expected condition of the facilities at the end of the contract term, will be described in the contract. The final evaluation of the project should be carried out by an independent engineer appointed by the department.
It is of utmost importance to follow the manufacturer's recommendations for operation and maintenance procedures. On the basis of the recommendations of the manufacturer of the various equipment, a schedule of preventive maintenance should be drawn in a simple language to be easily understood by the maintenance staff. It should be ensured that the schedule of maintenance is strictly followed. Only the recommended lubricants should be used. Sufficient space should be available for carrying out repairs and for keeping oil, grease, spare parts and tools, etc. It is necessary to have a good workshop for this purpose, particularly in case of large installations like the main pump stations. The repair of heavy equipment, depending upon the scope of repair involved, may require a truck, electric generator, flood lights with extension cords, a small crane for handling the materials safely during repairs. The workshop should have the facility of welding set, grinder, drilling machine, small lathe and any other equipment depending upon the scope of repair involved.

b. Preventive Maintenance

The main reason for setting up a preventive maintenance program is to prevent unscheduled outages from failure of pump station equipment. Depending on the circumstances, an unscheduled outage will be, at least, very inconvenient and can be extremely expensive. A successful program of preventive and routine maintenance will reduce equipment failures, extend the life of the equipment, and reduce the overall operating costs.

The maintenance program should be set up initially by each of the major equipment manufacturers. The manufacturers should be the foremost authority on what is required to keep the equipment operating properly. The manufacturers' maintenance and operating manuals will provide recommendations on lubricants, spare parts, maintenance procedures, and intervals between maintenance.

The contractor's engineer-in-charge of maintenance should have readily available with him the following information:

(i) Manufacture's guideline and catalogues for repair and maintenance of all equipment

(ii) Name and addresses of firms dealing in related spare parts

For the pump station maintenance program, it is important to utilize personal experience and the equipment's history in preparing a maintenance schedule. An effective maintenance program requires tailoring the schedule to the equipment and the conditions under which it operates. Maintenance performed more frequently than required can cause undue wear and tear to the equipment being serviced as well as being a waste of time, while insufficient maintenance will cause premature equipment failure and a reduced service life. It should be noted that some equipment, e.g., most lifting equipment, must be maintained on a regular basis to meet safety regulations.

An equipment maintenance record system is essential in establishing a successful preventive maintenance program. The record system should contain a description of the equipment and its location; manufacturer's data such as size, model, type, and serial number; pertinent electrical and mechanical data; schedule for preventive maintenance and periodic inspections, and data on repairs or maintenance performed including actual work accomplished, material used, number of hours required to accomplish the work, and the cost of labor and materials.

The most important point for the operator to understand is to know when to call for skilled assistance, for instance where there is trouble because of worn out bearing requiring proper alignment, etc. The operator should however be able to maintain logbooks properly and regularly indicating the fuel consumption, hours worked and quantity of water pumped, etc. The logbook of the equipment should also indicate the record of break downs and repairs, date wise and cost of repairs and consumption of fuel etc. This record would provide a fairly good idea and timely indication about the particular equipment being worn out, requiring major over-haul or replacement. It is extremely essential to provide communication and transport facilities at the plants. In case of emergency situations requiring some unexpected spare part or
materials, adequate communication and transport facility can only help to arrange the required material promptly.

In addition to the records for routine maintenance, a comprehensive report should be written after major overhauls or extraordinary maintenance describing the work done and how it was accomplished. Pertinent photographs should be included in the report. These reports, along with manufacturer's drawings and operation and maintenance manuals, should be kept in a history file where they are readily accessible to maintenance personnel.

Well-kept maintenance records are invaluable in any maintenance program. They provide the necessary information for establishing a preventive maintenance and inspection schedule and a spare parts inventory. The records can also provide some consistency in the program even when personnel turnover is high.

c. Predictive Maintenance

For predictive maintenance the maintenance program is scheduled based on the analysis of data collected on the condition of the machine or equipment, not necessarily on any set schedule. To be effective, the machine being monitored has to be instrumented sufficiently to obtain meaningful data. An automated means of collecting, storage, and analyzing the data is helpful as well. The most difficult part of a predictive maintenance program is setting the limits or alarms that indicate when failure is near and maintenance is required. More information and guidelines are becoming available, but there will always be some fine-tuning required for each individual application. Not all equipment lends itself to predictive maintenance, i.e., it will be more cost effective to continue with periodic maintenance rather than analyze data to determine the best time for action. A combination of predictive and preventive maintenance would provide the best maintenance program.

d. Inspection of Pump Station Equipment

The information in the Table below provides typical maintenance and inspection information for some of the most common mechanical and electrical equipment for a pump station. This information, combined with actual operating experience and manufacturer's recommendations, should be used to develop specific inspection schedules and check lists.

The checklist should be concise, but descriptive enough to leave no question to what information is required and how it should be obtained. For example, if a bearing temperature is to be checked, indicate where the thermometer is located and that the reading should be in degrees Centigrade. This should infer to the person performing the inspection that a simple check mark indicating the temperature is okay is not acceptable. The checklist should also include the range of acceptable values or conditions for each item on the list. This will allow the person performing the checks to quickly recognize a problem, and notify maintenance personnel.

Typical Inspection Interval and Inspection Items for Pump Station Equipment

<table>
<thead>
<tr>
<th>Interval</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine</td>
<td>- Suction pressure</td>
</tr>
<tr>
<td></td>
<td>- Discharge pressure</td>
</tr>
<tr>
<td></td>
<td>- Motor current</td>
</tr>
<tr>
<td></td>
<td>- Pump discharge</td>
</tr>
<tr>
<td></td>
<td>- Liquid temperature</td>
</tr>
<tr>
<td></td>
<td>- Bearing temperatures pump and motor</td>
</tr>
<tr>
<td></td>
<td>- Room temperatures</td>
</tr>
<tr>
<td></td>
<td>- Running noise and vibration (diagnosis by noise sensor and vibration monitoring system)</td>
</tr>
<tr>
<td></td>
<td>The data to be stored through pump station control and monitoring system.</td>
</tr>
</tbody>
</table>
Weekly
- Leakage from the pump shaft seal
- Gland packing type, to be adjusted
- Mechanical seal, leakage check

Monthly
- Check for pump to driver alignment
- Measure and record vibration amplitude (to be stored)

Quarterly (three month)
- Check of lubrication oil

Half-yearly
- Check pump to drive unit alignment (realign if necessary)
- Check of coupling (rubber, replace if required)
- Check of suction strainer, trash racks

Yearly
- Overhaul, inspection and maintenance
- Clearance check
- Replacement of damaged parts
- Replenishment of spare parts
- Inspection and maintenance of valves and pipelines
- Removal of scales

The same should be developed in O&M Manual for all component of work.

Suggested Staffing Pattern for MOM of Irrigation System
(per single main pump station and distribution network)

<table>
<thead>
<tr>
<th>Category</th>
<th>Entity</th>
<th>For control room</th>
<th>For pump room</th>
<th>For pipe distribution network</th>
<th>Delivery of irrigation water to farm hydrants</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager</td>
<td>DBO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Pump station manager</td>
<td>DBO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Maintenance supervisor</td>
<td>DBO</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Operator (mechanical)</td>
<td>DBO</td>
<td>4</td>
<td>3 per pump house</td>
<td>4</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Operator (electrical)</td>
<td>DBO</td>
<td>4</td>
<td>3 per pump house</td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Attendant (mechanical)</td>
<td>DBO</td>
<td>2</td>
<td>3 per P.H.</td>
<td>4</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Attendant (electrical)</td>
<td>DBO</td>
<td>2</td>
<td>3 per P.H.</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Agricultural specialist</td>
<td>DBO</td>
<td></td>
<td></td>
<td></td>
<td>1 per 30000 ha</td>
<td></td>
</tr>
<tr>
<td>Irrigation engineer</td>
<td>DBO</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Irrigation planner</td>
<td>DBO</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Field operator (valve operator)</td>
<td>DBO</td>
<td>One per 1000 ha</td>
<td>As required</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCADA technician</td>
<td>DBO</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Database administrator</td>
<td>DBO</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Driver</td>
<td>DBO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Watchmen/Security</td>
<td>DBO</td>
<td>6</td>
<td></td>
<td>As required</td>
<td>As required</td>
<td>18</td>
</tr>
<tr>
<td>Laborers</td>
<td>DBO</td>
<td>6</td>
<td></td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

The table shows the suggested staffing pattern for the operation and maintenance (O&M) of an irrigation system, including the number of staff required for various roles and locations.
**Penalty for Failure to Reach Production Outputs**

The performance damages due by the Contractor to the Employer, shall be as follows.

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount of Performance Damage</th>
<th>Evaluation Methodology</th>
<th>Allowable Exclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Build Period</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge of (Duty) I/s/ha for the net CCA of (Value of CCA) ha at 20m exit gradient at each 1 ha.</td>
<td>If discharge and head is less than 95% of requirement at outlet: Rs200/ha/day</td>
<td>Daily</td>
<td>Till rectified. With written instruction from MPWRD</td>
</tr>
<tr>
<td><strong>Operation Services Period</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interruption of operation</td>
<td>Damage: Rs 200 day/ha</td>
<td>A day is deemed non-compliant if the operation is interrupted (discharge or pressure not compliant with the requirement) 12 hours or more in the day.</td>
<td>With written instruction from MPWRD</td>
</tr>
<tr>
<td>Power consumption kW-hr/m³</td>
<td>If power consumption is more than 2% in excess of the values in schedule for the corresponding reservoir level: 3 times the prevailing rate of the kW-hr in excess.</td>
<td>Monthly</td>
<td>With written instruction from MPWRD</td>
</tr>
<tr>
<td>Conveyance efficiency of system</td>
<td>If the difference between water pumped and water delivered at field is more than 0.5% the penalty @ three times the prevailing rate of kW-hr for extra water pumped.</td>
<td>Volumetric</td>
<td>With written instruction from MPWRD</td>
</tr>
</tbody>
</table>