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Risk Management in EPC Contract - Risk Identification

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Abstract: *In this paper, we discuss the major risks identified in an EPC Contract which may affect the project. These are the practices as a part of risk management. The key benefits of this process is the documentation of existing risks and the knowledge and ability it provides to the project team to anticipate events.*

Risk identification is an iterative process, new risks may evolve or become known, as the project progresses through its life cycle. The frequency of iteration and participation in each cycle will vary by situation. The process should involve the project team so they can develop and maintain a sense of ownership and responsibility for the risks and associated risk response actions. Stakeholders outside the project team may provide additional objective information.

A case study of construction of a Radial Intake well (an EPC Contract) for a Thermal Power Plant has been considered for this research work.

Key Words: *Risks, Risk Identification, Risk Management, Radial Intake Wells, EPC Contract.*

I. Introduction

Project risk management is the art and science of managing risks caused by unforeseen changes (uncertainties) which may require deviations from the planned approach and may therefore affect the achievement of the project objectives. It involves systematically identifying, analyzing, planning and controlling risks.

Paper highlights the risks identified in Engineering Procurement & Construction Contracts (Turnkey) (E.P.C) as a part of risk management process. Identifying the major risk sources and quantifying them w.r.t likelihood, impact and severity in a complex infrastructure projects. The Case study for the research has been taken as construction of Raw Water Intake System for a Thermal Power Plant in Maharashtra, India by constructing a **Radial Intake Well** (Radial Collector well).

II. Case Study

Owner planned to set up a coal based thermal power plant in close proximity of all major resources. For that purpose a broad gauge railway connection availability along with the perennial river source of water, which is considered for the consumptive water requirement of the power station, were the priorities. To utilize both railway connection for bringing coal and getting water from the river for its consumptive use the site was finalized. Consultants were appointed to carry out a pumping out test to find feasibility of drawing water based on the field permeability of sand along with the depth of sand bed in river and the type and quality of sand.

M/S PRATHAMESH Project Engineering and Management Consultants, Nagpur (PRA) carried out the required tests and feasibility for the project and recommended Radial Collector Well for the project. The recommendations were made based on water required for the life span of project, site data conditions, pumping out tests, field permeability tests, depth of sand bed in river, quality of sand, geotech investigation, topographic surveys, field surveys, flood records, project maximum flood, project design flood, calculating highest flood level in river, references, standard codes and Manual on Water Supply and Treatment of The Central Public Health and Environmental Engineering Organisation [CPHEEO].

Keeping risks of all stakeholders under consideration owner approved the recommendations and tender was floated as a Lump Sum EPC turnkey contract on single responsibility (design and build) basis. Parties were invited with expertise in similar kind of job. Scope was set which included designing, construction of Radial Well in river, approach bridge, switchgear room, rising main from radial well to plant end reservoir with all appurtenances, pumping machinery at radial well, substation at radial well location and at plant end, 33KV overhead, single circuit, transmission line, full SCADA system etc and ROW.

Construction commenced in month of March-April 2011, execution work was divided in phases to organize the scope Radial well of ID- 9.2 m ID and OD- 12 m, by sinking method 10 m below RBL of total height 27 m with overhead pump house of size 16 x12x11.2 m. Approach Bridge with foundation and piers in RCC of width 5 m and length 150 m. Switch yard and sub-station, all pipe line structures. Radials: 300 mm dia steel radials pushed at 7 m below RBL. Total 15 nos of 525 m length. Bottom Plugging: by Tremie Method. Ref Figure 1 and Figure 1.1

FIGURE 1 : RADIAL WELL IN RIVER BED AQUIFER

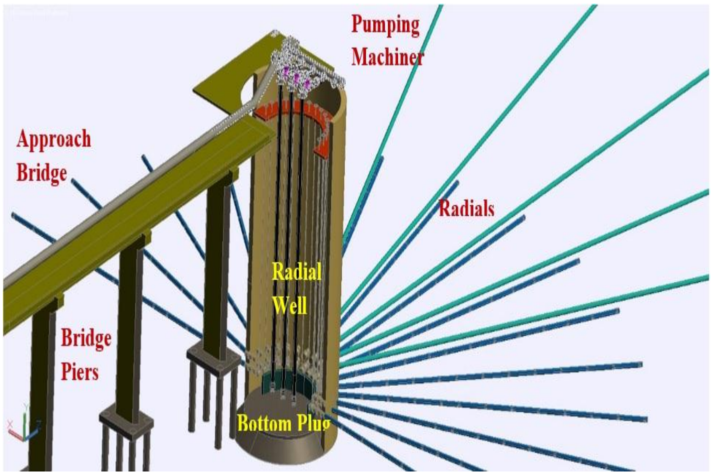

FIGURE 1.1: SECTIONAL VIEW OF RADIAL WELL

III. Methodology

To achieve the objective of this research, Brain-storming secessions and analysis of historic data for similar projects were found to be the most preferred method. Consultant (PRA) have achieved core competence in the field of water infrastructure with a vast experience, studies and detailed analysis, designs of various similar types of projects carried out overs years.

Experiences shared by managers, engineers, supervisors in tackling risks at various levels in these projects put forth during planning stage of a new project helps in overviewing the project and identifying the expected risk.

3.1) An unforeseen situation leading to an event, the occurrence of which is likely to deviate from the estimated or forecast value or planned path.

3.2) The probability of occurrence of the event.

3.3) Likely impact of that event, i.e loss or gain.

These major components of risks get covered during brainstorming secessions. Project schedule are very helpful in this respect. Summery schedule sheet of present case study can be seen in Figure 2.

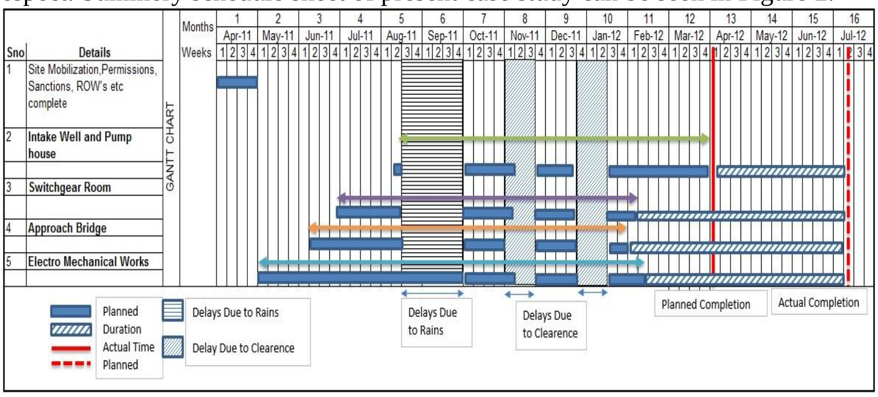

Figure 2 Summery Schedule Chart

While executing the project there were some delays in individual activities, as risk identification and sorting out was done in time by concerned stakeholders and thus ultimate effect on overall project was minimum.

Risks divided into risk events, most of them identified by breaking down the risk sources into manageable levels of details either by project objectives, work packages, management functions, brainstorming or judgment based on the knowledge of expert's or combination of these. This breakdown enables the risk planners to recognize the nature of risk events likely to be encountered.

IV. Sources of Risk

Number of risks are encountered with modern projects, right from concept to commissioning. Commonly encountered risk sources are commercial risks, design risks, natural disaster risk, cost overrun risk and time overrun risk. Some of the project risk sources are shown in table 1

Table 1 Project Risk Sources

External Environments Predictable Sources	Internal Environment		External Environments Unknown uncertainties
Political and Legal	Scope change, Time overrun, Cost Overrun	Leadership and organizational failure	Acts of God
Design and Specification	Technology Change	Resource Failure	Ecology
Financial and Economical	Quality and specification failure	Contractor Failure	Safety and Health

Based on project risk sources in Table 1, generalized risk identifications and classification involved in project are ref Table 2

Table 2 Classification of Risks Involved in Project

S. no	Risk Description	S.no	Risk Description
1	Project Scope Risk / Feasibility Risk	11	Force majeure & ecological Risk
2	Design & Specification Risk	12	Political, Legal and Social Risks
3	Quality Risk	13	Financial & Economical Risk
4	Time overrun Risk	14	Safety Health and environmental Risk
5	Cost Overrun Risk	15	Funding Failure Risk
6	Leadership Risk	16	Communication and network failure Risks
7	Organizational Risk	17	Project Execution Risks
8	Physical Resource mobilization and utilization Risk	18	Installation Risks of Mechanical and Electrical works.
9	Technology Risk	19	Purchase and Procurement Risks
10	Contractual Risk		

As sources of risks are identified, classifications are made and risks are indicated to various activities. Work is breakdown into manageable activities to get the grip on project and minimize the construction risks and delays. This breakdown and risk indication enables the risk planners to recognize the nature of risk events likely to be encountered. Details are furnished in table 3.

TABLE: 3 Work Breakdown with Risk identification

Sno	Activities	Risks Involved (Ref Table 2)
1	Permissions, Sanctions, ROW's(Right of Way) for Pipeline alignment's, etc complete	7,6,10,12,17,18
2	Site Mobilization, Site Office setup Approach Road etc Complete	1,4,6,8,14,16
3	Socketing and Sinking of Well	1,2,3,4,5,8,9,11,14,17,18
4	Placing RCC Concrete Plug (Bottom Plug)	1,2,3,4,5,8,9,11,14,17,18
5	Additional Soil investigations and test to overcome problems (if any)	1,2,4,5,9,13
5	Fixing temp Platform in side well	2,3,4,8,9,14,17,18
6	Radials Pushing	1,2,3,4,5,8,9,11,14,17,18
7	Construction of Intake well up to pump house floor.	2,3,4,6,8,9,11,14,17,18
8	Construction of Pump house up to roof bottom	1,2,3,4,5,6,8,9,11,14,17,18
9	Pump house roof completion	1,2,3,4,5,6,8,9,11,14,17,18
10	Complete finishing of Pump house and electrification.	1,2,3,4,5,6,8,9,11,14,17,18
11	Raft reinforcement with shuttering of switchgear room	1,2,3,4,6,8,9,11,14,17,18
12	Concreting of raft	1,2,3,4,6,8,9,11,14,17
13	Column and Beams up to slab	1,2,3,4,6,8,9,11,14,17
14	Stacking of boulder and murrum, back Filling Complete	1,2,3,4,5,6,8,9,10,11,14,17
15	Reinforcement of shuttering for roof slab	1,2,3,4,6,8,9,11,14,17,18
16	Construction of Columns – Beams and roof slab of switchgear room	1,2,3,4,6,8,9,11,14,17,18
17	Plastering of switchgear room	1,2,3,4,6,8,9,11,14,17

18	Painting of switchgear room	1,2,3,4,6,8,9,11,14,17
19	Fixing of side railing and electrification of switchgear room	2,3,8,14,18
20	Construction of precast concrete girder	1,2,3,4,5,6,8,9,11,14,17,18
21	Construction of Pile work including pile cap	1,2,3,4,5,8,9,11,14,17,18
22	Fabrication of shuttering for piers	1,2,3,4,6,8,9,11,14,17,18
23	Construction of piers	1,2,3,4,5,8,9,11,14,17,18
24	Placing of bridges girders & bridge slab casting	1,2,3,4,5,8,9,11,14,17,18
25	Plant end substation layout making	1,2,4,6,8,10,11,17
26	Construction of transformer foundation and firewall	1,2,3,4,6,8,9,11,14,17,18
27	Construction of outdoor equipment foundation	1,2,3,4,6,8,9,11,14,17,18
28	Laying of pipeline work along with PWD road	1,2,3,4,5,6,8,9,10,11,12,13, 14,15,16,17,18
29	Laying of pipeline complete including all accessories	1,2,3,4,5,6,8,9,10,11,12,13,14,15,16,1 7,18
30	Overhead line approvals	7,10,12
31	Electric items for substation and switchgear – Procurement	1,2,3,4,5,6,7,8,9,11,14, 15, 19
32	Electric items for substation and switchgear – Installation	1,2,3,4,5,6,7,8,9,11,14,15,18
33	Conductor, cables and hardware for transmission line- Procurement	1,2,3,4,5,6,7,8,9,11,14, 15,19
34	Conductor, cables and hardware for transmission line- Installation	1,2,3,4,5,6,7,8,9,11,14, 15,18
35	Pumps and motors with ancillary- Procurement	1,2,3,4,5,6,7,8,9,11,14, 15,19
36	Pumps and motors with ancillary- Installation	1,2,3,4,5,6,7,8,9,11,14, 15,18
37	Step up Transformer, CNR panel etc at plant end – Procurement	1,2,3,4,5,6,7,8,9,11,14, 15,19
38	Step up Transformer, CNR panel etc at plant end – Installation	1,2,3,4,5,6,7,8,9,11,14, 15,18
39	Instrumentation panel – Procurement	1,2,3,4,5,6,7,8,9,11,14, 15,19
40	Instrumentation panel – Installation & Commissioning	1,2,3,4,5,6,7,8,9,11,14, 15,18
41	All mechanical appurtenances like valves, EJ, etc - Procurement	1,2,3,4,5,6,7,8,9,11,14, 15,19
42	All mechanical appurtenances like valves, EJ, etc – Installing	1,2,3,4,5,6,7,8,9,11,14, 15,18

Execution completed in 15-16 months overshooting the stipulated completion time of 11 months. As shown in summery schedule sheet figure 2 above. Major idle time delays and reasons recorded are tabulated in table 4.

Table 4: Delay / Idle Time

Sno	Delay/Idle time (Days)	Remarks
1	42	Due to Heavy rains & Floods
2	39	Due to Govt Clearance problem

It is reflected from data that nearly 3 moths of time overrun occurred, resulted in linked cost overrun of overall project. Apart from this delay of nearly 3 months, project underwent smooth execution till completion. Present day status is project stands completed and is fully commissioned. Contractor has received major part of financial dues from owner's side and project stated as success for all stakeholders.

V. Approach to Risk Identification & Risk Management

Risk identification is an iterative process that involves the project team, stakeholders and other managers affected by or who affect the project, and finally outside individuals who can comment on the completeness of the risk identification based on their similar experiences.

The challenge lies in identifying beforehand all the risks that you might face so that the project team is well equipped and ready to mitigate it systematically. While it is a well-known fact that risk identification is a step by step process, i.e. new risks might appear only when the project reaches a certain level, this is exactly where analysis of historical data comes into play. The project team has to collect all possible relevant data of previous projects and take into account all the similar risks that can be linked even remotely. This can be done with the help of checklists and brain- storming sessions.

By identifying risks at an early stage of planning a construction project or a tender and assessing their relative importance, the project management can be adapted to reduce the risks and allocate them to the parties best able to control them or absorb them when they occur. Studies should be carried out early in the life of a project.

VI. Important Tools/Aspects in Risk Identification and Assessment

6.1) Work Breakdown Structure:

Before the commencement of the project all tasks are listed, broken down into manageable subtasks& the schedule is prepared via MS Project or Primavera. It breaks down activities into smaller and more specific sub-tasks which gives an exact idea of what needs to be done and the amount of resources to be spent on that task. It can have as many levels as possible. A WBS with the schedule is imperative in the risk identification particularly in an industrial project involving structural steel. The WBS in the schedule can be used to generate a BIM or VDC (Virtual Design Construction or 3D models) video which would give a clear idea of the activities to be performed in a chronological order.

6.2) Product Specification:

Product Specifications is a literature given to the contractors by the owners which gives a detailed description on how the product is to be executed. There are additional or new (other than the common ones) risks for products which have particularly different specification.

6.3) Method Statements for Typical activities:

During execution some activities are very typical. They require a prescribe way for successful completion for achieving 100% objective. Chronology and correct procedure of these activities & method statements prepared in advance and modified during executions are shared with contractor. This results speedy work and minimizing risks and delays.

6.4) Resource Plan:

Resources refer to men, materials & machinery. Resources are the Achilles heel of all the construction processes. In India there are more risks arising out of the lack of or management of resources rather than the activities themselves. Hence while brainstorming it is very important to assign the activities just the right amount of resources required.

Once Risks are identified, suitable engineering staff should work on:

- Defining readjustments in execution of activity if any,
    - During execution of activity.
    - After completion of activity.
- Increasing inputs in form of men materials labors in subsequent activities to reduce impact of delays & ultimate completion of project.

VII. Conclusion & Recommendations

Project Management is effective and efficient only when there is awareness of risk exposures and method of handling risks. The project being an EPC turnkey contract minimises the owner’s risks to some extent. But in situations where time is essence and completion of project is priority, efforts are equally taken by all stakeholders in the interest of project. Infrastructure projects related to marine conditions are more prone to risks as they directly come in contact with flowing water and harsh climatic conditions like floods etc .These projects require permissions and sanctions from various govt departments & require to collect data on floods and rainfalls for up to periods of 100 years which is a time consuming affair. Social impacts are comparatively high.

It is sometimes argued that risk identification process induces negative and cautious attitudes among the team or the project sponsors. Contrary to this, it can be said that the risk identification process, if developed with the participation of the project team, enables effective management of project.

Fast changing, unstable, risk prone environments cannot be stopped, however managers can prepare themselves for the resulting impacts of risks to their project. This in turn reduces exposure to project time, cost and performance risks.

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