

Report  
on  
Cost Vetting of New Umtru Hydro Electric Project  
40 MW (2 x 20 MW)

Submitted to  
Chief Engineer (HP&HC)  
Meghalaya Power Generation Corporation Limited  
Shillong – 793001



Infrastructure Engineering and Management Division  
Department of Civil Engineering  
Indian Institute of Technology Guwahati  
Guwahati – 781 039

## Introduction

The Meghalaya Power Generation Corporation Limited (MePGCL) has been entrusted with the development of New Umtru Hydro Electric Power Project 40 MW (2 x 20 MW) in Ri Bhoi district of Meghalaya. The New Umtru Hydro Electric Project (NUHEP) was built alongside the old Umtru Project with common water storage and a new dam was built at the location of the old dismantled Umtru weir of the old project to create enhanced water storage for old and new projects.

The project was approved in December 2007 at a sanctioned cost of INR 226.40 crore (@ March 2005 price). The project encountered several challenges relating to design, land acquisition and financing and it could be completed only in 2017. The project, thus, entered into commercial operation in July 2017 (i.e. COD is 1<sup>st</sup> July 2017).

With respect to this project, MePGCL has approached IIT Guwahati to undertake assignment of vetting the revised project cost of New Umtru Hydro Electric Project via their letter no. CE/C/HP&HC/T-24(Pt-XI)/2017/37, dated October 04, 2017. Subsequent to this, the team from IITG visited the project site on October 17<sup>th</sup>, 2017 and had a meeting with the Chief Engineer, MePGCL on 27<sup>th</sup> November 2017 regarding the proposed consultancy assignment.

## Objectives of the Study

The key objective of the study is vetting of the revised cost of the New Umtru Hydro Electric Power Project (2 x 20 MW) project through examination of the various components of the project cost. The vetting of the project's capital cost will also involve analysis of time and cost overrun during the execution of the project.

## Work Plan

The proposed methodology for the study will comprise of the following stages:

- **Stage I:** Site visit to get a first-hand information of the project site (accessibility, topography & geology), infrastructure works, project components, transmission lines and sub stations.
- **Stage II:** Review of the various project documents such as:
  - Detailed Project Report (DPR) & Techno-economic Clearance (TEC)
  - Implementation Agreement
  - Tender document for infrastructure, civil, hydro-mechanical (H&M), and electro-mechanical (E&M) works
  - Bid evaluation report for infrastructure, civil, H&M, and E&M works
  - Contract Documents for infrastructure and civil and H&M works
  - Contract Documents for Electro-mechanical (E&M) works
  - Original and revised PERT schedule of the project
  - Progress Reports
  - Break up of completed cost estimate
  - As built drawings for main civil works
  - Executed quantities of infrastructure works and civil works for main civil works

- **Stage III:** Review of the DPR cost will be undertaken for Civil works, H&M works, E&M works, and other works by first calculating the quantities of different work items involved and multiplying with the applicable unit rates. Then, the appropriateness of the applicable unit rates would be worked out considering the applicable basic item rates prevailing in Meghalaya, labour rates and cost of transportation including loading, unloading & stacking charges.
- **Stage IV:** Review of the revised cost estimate will be undertaken for Civil works, H&M works, E&M works, and other works by first calculating the quantities involved and multiplying with applicable unit rates. The applicable unit rates will, then, be examined for appropriateness by looking into comparable applicable basic rates in Meghalaya for similar work items, if available. The quantities used in calculation of the work item costs will also be reviewed to understand the basis for the quantity survey.
- **Stage V:** Review of the actual completed cost of the project to ascertain the costs relating to Civil works, H&M works, E&M works and other works. Subsequently, these costs will be compared with the revised cost estimates to ascertain the variation, if any. In case for those work items with cost variance, the reason for the variance could be attributed to increase/decrease in scope of work and/or increase/decrease of unit rate of the work item. The reasons for the change in scope of work and unit rate will be reviewed with the main objective of arriving at the decision whether this increase could be attributed to the project or not.
- **Stage VI:** Time overrun analysis will be carried out by first drawing up the schedule of the project as per the original completion period. The events which have contributed to time overrun will be reviewed to see whether these events are legitimate as per the contractual provisions. The events will then be introduced in the original schedule to ascertain whether these delays have resulted in project delay.
- **Stage VII:** Cost overrun analysis of the project will be carried out to ascertain the reasons for the cost variance observed for those work items identified in Stage V. Furthermore, the period within which the cost overrun has been observed will also be looked into in order to ascertain whether the events have occurred during the original contract period or not.

## Project Cost - DPR

The cost estimate of the New Umtru H. E. power project has been based on the rates of the various items of works adopted for the Leishka H. E. project, which was executed by Meghalaya State Electricity Board (MSEB). The basic rates have been derived from the rates of similar items of works applicable across Meghalaya. For example, the cost of basic materials such as cement, steel, sand and aggregates have been adopted from various sources such as Meghalaya PWD Schedule of Rates for 2004-05 for roads and buildings and ex-factory or ex-quarry applicable in Guwahati or in specific locations in Meghalaya. For cement, the ex-factory rates from cement factories within Meghalaya and in Guwahati had been considered as the likely sources for supply to the project. Ex-Guwahati Railway Station rates as per the rates of SAIL, ex-Guwahati for March 2005, had been considered as the rates

for both structural steel and reinforcement. Sand was proposed to be extracted from Umtru river bed or Brahmaputra and rates for the same given in PWD Schedule of Rates 2004-05 had been considered with a carriage distance of 10 km from river bed quarry. Similarly, rates for coarse aggregates had also been adopted from Meghalaya PWD Schedule of Rates 2004 - 05. The hire charges of the various construction equipment had been based on rates given by CMC, Directorate of CWC, which had been upgraded to account for inflation and escalation as per WPI. Finally, the daily rates of various categories of workmen were based on the Meghalaya PWD Schedule of Rates 2004-05.

Besides the basic rates, the quantities were based on the planning and preliminary design of different components of works after review of site conditions, detailed field investigations and analysis. The cost of the project was estimated to be INR 194.29 crore (at March 2005 price) as per the DPR. The component of project cost towards civil works was estimated to be INR 120.92 crore and INR 73.37 crore towards electrical works. The DPR cost did not include the IDC and financial charges.

### Civil Works

The cost of the civil works was estimated to be INR 12,092 lakhs as per the records while the cost of civil works computed as per the present study has been estimated to be INR 12,674 lakhs. Table 1 shows the break-up of the civil works vis-à-vis the cost as per the records and based on the present study. Major proportion of the civil works cost is towards two categories of works – (i) River care works, modification of existing masonry dam, new power intake structure, and related hydro-mechanical works, and (ii) Power plant civil works. Cost of power plant civil works comprised of costs of head race tunnel, surge shaft, pressure shaft, power house complex, tail race tunnel and outlet works, switchyard, and related hydro-mechanical works. The cost of power plant civil works was estimated to be INR 5,628 lakhs while the cost allocated towards the former head was INR 3,221 lakhs as per the records. On the other hand, the cost of power plant civil works have been found to be INR 5,984 lakhs as per the present study.

Provisions towards permanent and temporary residential and non-residential buildings is the next sub-head of civil works with substantial cost. The non-residential buildings include offices, workshops, stores, rest houses, field hostels, hospital, school and other utility services. The costs for these buildings were estimated based on the plinth area rate prevalent in the project area. The total provision under this sub-head has been INR 695 lakhs as per the records, while the computed value is INR 704 lakhs.

The provision towards the sub-head preliminary was INR 380 lakhs, as per the records while the computed cost under this head is INR 440 lakhs. Under this head, provision for topographical surveys, geological and geophysical investigations, tests on rocks, collection of hydrological and meteorological data, hydraulic modeling studies, environmental and ecological studies, and preparation of project reports have been included. With respect to head land, most of the land required for the project has already been under the possession of MeSEB, provision under land has been towards acquisition of land for permanent works, approach roads, workshops, stores, offices and permanent colony for the maintenance staff.

Table 1 – DPR Civil Works – Comparison of Costs as per Records and Present Cost Model

| Item                 | Major Scope of Work                             | DPR Cost (INR Lakhs) |                    | Cost Variation | % Variation |
|----------------------|---|----------------------|--------------------|----------------|-------------|
|                      |   | As per Records       | As per Calculation |                |             |
| 1                    | 2   | 3                    | 4                  | 4 - 3          | (4 - 3)/3   |
| <i>Direct Cost</i>   |   |                      |                    |                |             |
| <i>I - Works</i>     |   |                      |                    |                |             |
|                      | A - Preliminary                                 | 380.00               | 440.00             | 60.00          | 15.79%      |
|                      | B - Land  | 150.00               | 150.00             | -              | -           |
|                      | C - Civil Works                                 |                      |                    |                |             |
|                      | i. River care                                   | 130.00               | 130.00             | -              | -           |
|                      | ii. Dam   | 1,171.76             | 1,171.52           | (0.24)         | -0.02%      |
|                      | iii. Intake                                     | 1,066.13             | 1,066.15           | 0.02           | 0.00%       |
|                      | iv. Hydro Mechanical                            | 852.94               | 852.73             | (0.21)         | -0.02%      |
|                      | Sub-total – Civil Works                         | 3,220.83             | 3,220.41           | (0.42)         | -0.01%      |
|                      | J - Power Plant Civil Works                     |                      |                    |                |             |
|                      | i. Head race tunnel                             | 874.49               | 784.12             | (90.37)        | -10.33%     |
|                      | ii. Surge shaft                                 | 745.27               | 422.59             | (322.68)       | -43.30%     |
|                      | iii. Pressure shaft / Penstock                  | 422.58               | 748.18             | 325.60         | 77.05%      |
|                      | iv. Power house complex                         | 2,141.16             | 2,598.51           | 457.35         | 21.36%      |
|                      | v. Tail race tunnel                             | 1,001.29             | 1,001.29           | -              | -           |
|                      | vi. Switchyard                                  | 208.90               | 208.92             | 0.02           | 0.01%       |
|                      | vii. Hydro mechanical works                     | 227.68               | 220.50             | (7.18)         | -3.15%      |
|                      | Sub Total - J - Works                           | 5,628.37             | 5,984.11           | 355.74         | 6.32%       |
|                      | K - Building                                    | 695.07               | 704.07             | 9.00           | 1.30%       |
|                      | M - Plantation                                  | 14.00                | 13.80              | (0.20)         | -1.41%      |
|                      | O - Miscellaneous                               | 449.00               | 449.00             | -              | -           |
|                      | P - Maintenance during Construction             | 102.92               | 106.56             | 3.64           | 3.54%       |
|                      | Q - Special T & P                               | 129.14               | 129.14             | -              | -           |
|                      | R - Communication                               | 205.00               | 205.00             | -              | -           |
|                      | X - Environment & Ecology                       | 80.00                | 80.00              | -              | -           |
|                      | Y - Losses on stock                             | 26.24                | 26.24              | -              | -           |
|                      | II. Establishment                               | 868.05               | 908.67             | 40.62          | 4.68%       |
|                      | III. Tools and Plants                           | 110.80               | 116.17             | 5.37           | 4.85%       |
|                      | IV. Suspense                                    | -                    | -                  | -              | -           |
|                      | V. Receipt and Recoveries                       | (78.55)              | (78.55)            | -              | -           |
| <i>Indirect Cost</i> |   |                      |                    |                |             |
|                      | a). Capitalisation of Abatement of Land Revenue | 110.80               | 110.80             | -              | -           |
|                      | b). Audit and Account Charges                   | -                    | -                  | -              | -           |
|                      | Total of Civil Works                            | 12,091.67            | 12,674.16          | 582.49         | 4.82%       |

As per the cost estimation methodology prescribed by CWC (1997), the provision under sub-head *A - Preliminary* should be between 1 - 2% of the total cost of *I - Works*. As per this, the provision should be around INR 232 lakhs (or INR 222 lakhs as per records), however the provision towards this sub-head has exceeded this limit. With respect to *K - Buildings*, the provision in the cost estimate are within the limit set by CWC (1997). As per this, provision towards *K - Buildings* could be up to INR 980 lakhs, while the provision in the cost estimate is INR 704 lakhs (INR 695 lakhs, as per records). Regarding provision for *O - Miscellaneous*, the provision in the cost estimate is within the limit of 4% of cost of *I-Works* as per CWC (1997), however it exceed the limit of 3% of the cost of *I - Works* as per CEA (2015). With respect to provision under sub-head *P - Maintenance*, the allocation towards this sub-head in the cost estimate is within the limit set by CWC (1997). As per CWC (1997), provision towards *P - Maintenance* could be limited to 1% of the cost of *I-Works* less the costs towards *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P*, and *X - Environment & Ecology*. Following this limit, the prescribed cost towards this

sub-head is around INR 109 lakhs (INR 108 lakhs, as per records) while the allocation in the cost estimate towards this sub-head is INR 107 lakhs. On the other hand, this provision in the cost estimate exceeds the prescribed limit if we take into consideration the limit set by CEA (2015). As per this methodology, provision towards the head *P - Maintenance* should be INR 95 lakhs. The provision towards the sub-head *Q - Special T&P* is well within the token provision of INR 200 lakhs (CEA, 2015), as the allocation in the cost estimate is INR 129 lakhs. Similar to the case of the provision under sub-head *P - Maintenance*, the provision towards sub-head *Y - Losses on stock* as per CWC (1997) has been set as 0.25% of cost of *I - Works* less the cost of sub-heads relating to *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P*, and *X - Environment & Ecology*. While, the limit as per CEA (2015) has been set as 0.25% of the cost of sub-heads towards *C - Works*, *J - Power Plant Civil Works*, and *K - Buildings*. And, as per this, the prescribed cost is around INR 25 lakhs (INR 24 lakhs, as per records), while the allocated cost is the cost estimate is INR 26 lakhs.

With respect to head *II - Establishment*, the provision towards should be calculated as 8% of the cost of *I - Works* less the cost of sub-head *B - Land* (CWC, 1997). As per this, the establishment cost should be INR 909 lakhs, however provision in cost estimate is around INR 868 lakhs. In the DPR, cost towards this head has been calculated on the basis of 8% of the cost of *I - Works* less the cost of *B - Land* and *X - Environment & Ecology*. The provision towards the head *III - Tools & Plants* in the DPR is as per the recommended practice of CWC (1997), which is the at the rate of 1% of the cost of *I - Works*.

With respect to *V - Receipts & Recoveries*, the provisions should be at the rate of 15% of the cost of temporary buildings along with the recoveries from resale of *Special T&P* (CWC, 1997). As per this norms, the provision under this head should be computed by setting the resale value of temporary buildings and *Special T&P* at INR 351.48 lakhs, and INR 129.15 lakhs. As per this norms, the corresponding provisions towards the head *V - Receipts & Recoveries* from *Buildings* and *Special T&P* are INR 52.72 lakhs and INR 129.15 lakhs. However, the estimated provision relating to *Special T&P* has been set at 20% of the cost of *Special T&P* (INR 25.83 lakhs).

The provision under the head *Indirect Charges* include charges towards *Audit and Account Charges @ 1% of cost of I - Works* and charges for *Capitalization of Abatement of Cost of Land Revenue @5% of the culturable land*. Provisions under the head *Audit and Account Charges* in both the estimates have been set at 1% of cost of *I - Works*. On the other hand, there is no provision towards the charges for *Capitalization of Abatement of Cost of Land Revenue* in both the estimates.

## Electro-Mechanical Works

The break-up of the electrical works is shown in Table 2. The cost estimate of electro-mechanical works comprised of prices of turbines, generators, major auxiliary equipment (E.O.T crane, transformers, batteries, control and relay panels) and other services such as erection, commissioning, and transportation. Based on the past experience of similar installations, erection and commissioning charges was estimated at the rate of 8% of the cost of equipment. As per the records, the total cost of electro-mechanical works was estimated to be INR 7338 lakhs in DPR while the same cost was found to be INR 7,343 lakhs on computation.



Table 2 - Electrical Works as per DPR – Comparison of Costs as per Records and Present Cost Model

All figures are in Lakhs

| Sl. No. | Item  | Cost as per DPR |                    | Cost Variation | % Variation |
|---------|---|-----------------|--------------------|----------------|-------------|
|         |   | As per Records  | As per Calculation |                |             |
| 1       | 2   | 3               | 4                  | 4 - 3          | (4 - 3)/3   |
| 1       | Preliminary   | 215.00          | 215.00             | -              | -           |
| 2       | Generating Plant and Equipment  |                 |                    |                |             |
| a       | Generator, Turbine and Accessories  | 3,499.64        | 3,499.65           | 0.01           | 0.00%       |
| b       | Auxiliary electrical equipment for power station  | 1,166.69        | 1,154.29           | (12.40)        | -1.06%      |
| c       | Auxiliary equipment and services for power station  | 367.08          | 367.08             | -              | -           |
| d       | Central Sales Tax @ 4% on 2(a), (b), & (c)  | 201.34          | 200.84             | (0.50)         | -0.25%      |
| e       | Transportation, Handling and Insurance charges @ 6% of 2(a), (b), (c)                         | 302.00          | 301.26             | (0.74)         | -0.24%      |
| f       | Erection and commissioning charges @ 8% of 2(a), (b), & (c) less Spares                       | 376.09          | 398.30             | 22.21          | 5.91%       |
|         | Total Generating Plant and Equipment  | 5,912.84        | 5,921.42           | 8.58           | 0.15%       |
| 3       | Substation Equipment and Auxiliary Equipment  |                 |                    |                |             |
| a       | Substation equipment and auxiliary equipment for switchyard                                   | 247.48          | 244.48             | (3.00)         | -1.21%      |
| b       | Central sales tax @ 4% of 3 (a)   | 9.90            | 9.78               | (0.12)         | -1.22%      |
| c       | Transportation, handling and insurance charges @8% of 3 (a) less spares                       | 14.85           | 14.67              | (0.18)         | -1.22%      |
| d       | Erection and commissioning charges @8% of 3(a) less spares                                    | 19.36           | 19.12              | (0.24)         | -1.26%      |
|         | Total (Sub-station equipment and auxiliary equipment and service of switchyard)               | 291.59          | 288.04             | (3.55)         | -1.22%      |
| 4       | Losses on stock @ 0.25% on items 2 & 3 except erection and commissioning charges              | 14.52           | 14.48              | (0.04)         | -0.27%      |
| 5       | Maintenance during construction @ 1% on items 2 & 3 except erection and commissioning charges | 58.09           | 57.92              | (0.17)         | -0.29%      |
| 6       | Procurement and inspection charges @2% of items 2&3 except erection and commissioning charges | 116.18          | 115.84             | (0.34)         | -0.29%      |
| 7       | Contingencies @ 3% in items 2&3   | 186.13          | 186.13             | -              | -           |
| 8       | Total (Item 1 to 7)   | 6,794.35        | 6,798.99           | 4.64           | 6.83%       |
| 9       | Establishment @ 6% of item 8  | 407.66          | 407.94             | 0.28           | 0.07%       |
| 10      | T&P @ 1% on item 8  | 67.94           | 67.99              | 0.05           | 0.07%       |
| 11      | Audit & Account Charges @ 1% of item 8  | 67.94           | 67.99              | 0.05           | 0.07%       |
|         | Grand Total   | 7,337.90        | 7,342.91           | 5.01           | 0.07%       |

## Approved Project Cost

Central Electricity Authority vetted the estimated cost of the project at INR 17,213 lakhs against the estimated cost of INR 19,429 lakhs as per DPR. The costs of civil works and electrical & mechanical works have been revised to INR 11,118 lakhs and INR 6,095 lakhs, respectively. Table 4 and Table 7 shows these comparison for civil works and electrical & mechanical works, respectively. These vetted costs were lower than the estimated costs as per DPR by 8.05% and 16.94%, respectively. Review of the project cost approved by CEA has indicated that the actual approved cost should be INR 17,447 lakhs against the value of INR 17,213 lakhs.

## Civil Works

The comparison of the cost of civil works as per the records and based on the present calculation is shown in Normally, as per the CWC (1997) and CEA (2015) guidelines, the provision towards *A - Preliminary* should be @1 – 2% of the total cost of *I - Works*. However, the cost allocated to this head is beyond this norm (approximately around 2.96% of the cost of *I - Works*). With respect to the heads such as *B - Land*, *C - Works*, *J - Power Plant Civil Works*, and *M - Plantation*, no specific norms have been set and the estimates should be based on the actual cost. For the head relating to *K - Buildings*, as per the CWC (1997), the provision for the cost of buildings in hilly region could be estimated @ 6% – 8% of the cost of *I - Works*. Provision relating to this head in both the cases has been set at around 4.5% of *I - Works*. With respect to the cost head *O - Miscellaneous*, provision under this head as per CWC (1997) has been set at 4% of cost of *I - Works*, while as per CEA (2015), the provision should not exceed @3% of cost of *I - Works* up to INR 1,000 crores limited to INR 20 crores. The provision in both the estimates have been set around 2.50% of the cost of *I - Works*. With respect to cost head *P - Maintenance*, the provision as per CWC (1997) should be 1% of the cost of *I - Works* less costs under heads *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P* and *X - Environment* while as per CEA (2015), the provision under this head should be set at 1% of the total cost under heads of *C - Works*, *J - Power House*, and *K - Buildings*. With respect to both these norms, the provision towards the item *P - Maintenance* have been around 1.05% and 0.92% relating to the respective norms of CWC (1997) and CEA (2015). In the similar lines, the provisions against the cost head *Q - Special T&P* in the both the estimates have been set at INR 59 lakhs and INR 82.25 lakhs while as per the norms, CEA (2015), a token amount of INR 200 lakhs can be provided under this head. For the provision under cost head *Y - Losses on Stock*, the norm as per CWC (1997) is at 0.25% of cost of *I - Works* less costs under heads *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P* and *X - Environment* while as per CEA (2015), the provision under this head should be set at 0.25% of the total cost under heads of *C - Works*, *J - Power House*, and *K - Buildings*. The provisions in both the estimates for this head have been estimated to be slightly above the given norms, around 0.26%, specified by CWC (1997), while the provisions are beyond the norms, around 0.23%, specified by CEA (2015).

As per CWC (1997), the cost provision towards *II - Establishment* should be 8% to 10% of the cost of *I - Works* less the value of *B - Land*, while as per CEA (2015), it is set at 5% of the cost of *I - Works*. The cost provision towards *II - Establishment* following the methodology of CWC (1997) should be INR 739 lakhs and INR 766 lakhs, based on the approved cost as per the records and consultant's calculation, respectively. The provisions in both the estimates with respect to *II - Establishment* is well within the limit. For the cost item *III - Tools & Plants*, the provision as per CWC (1997) should be 1% of the cost of *I - Works* less the cost of *Land*, whereas as per CEA (2015), it is recommended that a token provision of INR 1 – 2 crores under this head may be adequate. As per the records, the provision under this head is well below the limit while the computed value of the provision towards this should be around INR 106.98 lakhs.

With respect to *V - Receipts & Recoveries*, the provisions should be at the rate of 15% of the cost of temporary buildings along with the recoveries from resale of *Special T&P* (CWC, 1997). As per this norms, the provision under this head should be computed by setting the resale value of temporary buildings and *Special T&P* at INR 299.36 lakhs, and INR 82.25 lakhs. As per this norms, the corresponding provisions towards the head *V - Receipts & Recoveries* from *Buildings* and *Special T&P* are INR 44.90 lakhs and INR 82.25 lakhs.



However, the estimated provision relating to *Special T&P* has been set at 20% of the cost of *Special T&P* (INR 16.06 lakhs).

The provision under the head *Indirect Charges* include charges towards *Audit and Account Charges @ 1% of cost of I - Works* and charges for *Capitalization of Abatement of Cost of Land Revenue @5% of the culturable land*. Provisions under the head *Audit and Account Charges* in both the estimates, however, have been set at 0.05% of cost of *I – Works*. Finally, in both the estimates, there is no provision towards the charges for *Capitalization of Abatement of Cost of Land Revenue*.

Table 3. It could be observed that cost of civil works as per records is lowered than the computed cost by about INR 330 lakhs. The difference between these two is mostly with respect to cost estimates for *Intake* and *Power House Complex* under cost items *I – Works*, and *J – Power Plant Civil Works*, respectively. The provisions towards the remaining items of works under the main cost head *I – Direct Works* are almost equivalent, except for items such as *Q – Special T&P*, and *X – Environment and Ecology*. Normally, as per the CWC (1997) and CEA (2015) guidelines, the provision towards *A - Preliminary* should be @1 – 2% of the total cost of *I - Works*. However, the cost allocated to this head is beyond this norm (approximately around 2.96% of the cost of *I - Works*). With respect to the heads such as *B - Land*, *C - Works*, *J - Power Plant Civil Works*, and *M - Plantation*, no specific norms have been set and the estimates should be based on the actual cost. For the head relating to *K - Buildings*, as per the CWC (1997), the provision for the cost of buildings in hilly region could be estimated @ 6% – 8% of the cost of *I - Works*. Provision relating to this head in both the cases has been set at around 4.5% of *I - Works*. With respect to the cost head *O - Miscellaneous*, provision under this head as per CWC (1997) has been set at 4% of cost of *I – Works*, while as per CEA (2015), the provision should not exceed @3% of cost of *I - Works* up to INR 1,000 crores limited to INR 20 crores. The provision in both the estimates have been set around 2.50% of the cost of *I - Works*. With respect to cost head *P - Maintenance*, the provision as per CWC (1997) should be 1% of the cost of *I - Works* less costs under heads *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P* and *X - Environment* while as per CEA (2015), the provision under this head should be set at 1% of the total cost under heads of *C - Works*, *J - Power House*, and *K - Buildings*. With respect to both these norms, the provision towards the item *P – Maintenance* have been around 1.05% and 0.92% relating to the respective norms of CWC (1997) and CEA (2015). In the similar lines, the provisions against the cost head *Q - Special T&P* in the both the estimates have been set at INR 59 lakhs and INR 82.25 lakhs while as per the norms, CEA (2015), a token amount of INR 200 lakhs can be provided under this head. For the provision under cost head *Y - Losses on Stock*, the norm as per CWC (1997) is at 0.25% of cost of *I - Works* less costs under heads *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P* and *X - Environment* while as per CEA (2015), the provision under this head should be set at 0.25% of the total cost under heads of *C - Works*, *J - Power House*, and *K - Buildings*. The provisions in both the estimates for this head have been estimated to be slightly above the given norms, around 0.26%, specified by CWC (1997), while the provisions are beyond the norms, around 0.23%, specified by CEA (2015).

As per CWC (1997), the cost provision towards *II - Establishment* should be 8% to 10% of the cost of *I - Works* less the value of *B – Land*, while as per CEA (2015), it is set at 5% of the cost of *I - Works*. The cost provision towards *II - Establishment* following the methodology of CWC (1997) should be INR 739 lakhs and INR 766 lakhs, based on the approved cost as per the records and consultant’s calculation, respectively. The provisions in

both the estimates with respect to *II – Establishment* is well within the limit. For the cost item *III - Tools & Plants*, the provision as per CWC (1997) should be 1% of the cost of *I – Works* less the cost of *Land*, whereas as per CEA (2015), it is recommended that a token provision of INR 1 – 2 crores under this head may be adequate. As per the records, the provision under this head is well below the limit while the computed value of the provision towards this should be around INR 106.98 lakhs.

With respect to *V - Receipts & Recoveries*, the provisions should be at the rate of 15% of the cost of temporary buildings along with the recoveries from resale of *Special T&P* (CWC, 1997). As per this norms, the provision under this head should be computed by setting the resale value of temporary buildings and *Special T&P* at INR 299.36 lakhs, and INR 82.25 lakhs. As per this norms, the corresponding provisions towards the head *V - Receipts & Recoveries* from *Buildings* and *Special T&P* are INR 44.90 lakhs and INR 82.25 lakhs. However, the estimated provision relating to *Special T&P* has been set at 20% of the cost of *Special T&P* (INR 16.06 lakhs).

The provision under the head *Indirect Charges* include charges towards *Audit and Account Charges @ 1% of cost of I - Works* and charges for *Capitalization of Abatement of Cost of Land Revenue @5% of the culturable land*. Provisions under the head *Audit and Account Charges* in both the estimates, however, have been set at 0.05% of cost of *I – Works*. Finally, in both the estimates, there is no provision towards the charges for *Capitalization of Abatement of Cost of Land Revenue*.

Table 3 Civil Works – Comparison of Approved Costs as per Records and Consultant's Calculation

| Item        | Major Scope of Work                 | Approved Cost  |                    | Cost Variation | % Variation |
|-------------|-------------------------------------|----------------|--------------------|----------------|-------------|
|             |                                     | As per Records | As per Calculation |                |             |
| 1           | 2                                   | 3              | 4                  | 4-3            | 4-3/3       |
| Direct Cost |                                     |                |                    |                |             |
| I - Works   |                                     |                |                    |                |             |
|             | A - Preliminary                     | 309.17         | 309.17             | -              | -           |
|             | B - Land                            | 150.00         | 150.00             | -              | -           |
|             | C - Civil Works                     |                |                    |                |             |
|             | i. River care                       | -              | -                  | -              | -           |
|             | ii. Dam                             | 1248.64        | 1,248.64           | -              | -           |
|             | iii. Intake                         | 843.34         | 926.37             | 83.03          | 9.85%       |
|             | iv. Hydro Mechanical                | 723.63         | 723.64             | -              | -           |
|             | Sub-total – Civil Works             | 2815.61        | 2,898.65           | 83.04          | 2.95%       |
|             | J - Power Plant Civil Works         |                |                    |                |             |
|             | i. Head race tunnel                 | 818.21         | 818.22             | -              | -           |
|             | ii. Surge shaft                     | 487.05         | 473.23             | (13.82)        | -2.84%      |
|             | iii. Pressure shaft / Penstock      | 722.46         | 722.46             | -              | -           |
|             | iv. Power house complex             | 2367.38        | 2,484.82           | 117.44         | 4.96%       |
|             | v. Tail race tunnel                 | 1042.11        | 1,042.08           | -              | -           |
|             | vi. Switchyard                      | 179.99         | 179.99             | -              | -           |
|             | vii. Hydro mechanical works         | 185.57         | 185.58             | -              | -           |
|             | Sub Total - J - Works               | 5802.77        | 5,906.37           | 103.60         | 1.79%       |
|             | K - Building                        | 477.48         | 477.45             | (0.03)         | -0.01%      |
|             | M - Plantation                      | 14.00          | 13.80              | (0.20)         | -1.43%      |
|             | O - Miscellaneous                   | 264.00         | 264.00             | -              | -           |
|             | P - Maintenance during Construction | 95.13          | 100.32             | 5.19           | 5.46%       |
|             | Q - Special T & P                   | 59.13          | 82.25              | -              | -           |
|             | R - Communication                   | 416.84         | 416.84             | -              | -           |
|             | X - Environment & Ecology           | 30.00          | 55.00              | 25.00          | 83.33%      |

| Item          | Major Scope of Work                             | Approved Cost  |                    | Cost Variation | % Variation |
|---------------|---|----------------|--------------------|----------------|-------------|
|               |   | As per Records | As per Calculation |                |             |
| 1             | 2   | 3              | 4                  | 4-3            | 4-3/3       |
|               | Y - Losses on stock                             | 23.78          | 24.37              | 0.59           | 2.48%       |
|               | II. Establishment                               | 618.47         | 650.86             | 32.39          | 5.24%       |
|               | III. Tools and Plants                           | 50.00          | 106.98             | 56.98          | 113.96%     |
|               | IV. Suspense                                    | -              | -                  | -              | -           |
|               | V. Receipt and Recoveries                       | (60.97)        | (60.96)            | 0.01           | -0.02%      |
| Indirect Cost |   |                |                    |                |             |
|               | a). Capitalisation of Abatement of Land Revenue | -              | -                  | -              | -           |
|               | b). Audit and Account Charges                   | 52.29          | 52.29              | -              | -           |
|               | Total of Civil Works                            | 11,117.70      | 11,447.39          | 329.69         | 2.97%       |

The comparison of the approved cost and DPR cost as per the records relating to Civil Works is shown in Table 4. It could be observed that the key differences under the head *C – Civil Works* are relating to items such as *River Care*, *Intake*, and *Hydro Mechanical works* which have been reduced in the approved cost while a higher provision has been made in approved cost relating to the item – *Dam*. Similar trends could also be observed with respect to items under *J – Power Plant Civil Works*. Under this item head, all the items except provisions for *Pressure Shaft*, *Power House Complex*, and *Tail Race Tunnel* have been increased in the approved project cost.

Table 4 Civil Works – Comparison of DPR Cost and Approved Cost as per Records

All cost figures in INR Lakhs

| Item        | Major Scope of Work                 | DPR Cost (Mar 2005) | Approved Cost (2008) | Cost Variation | % Variation |
|-------------|-------------------------------------|---------------------|----------------------|----------------|-------------|
| 1           | 2                                   | 3                   | 4                    | 4-3            | 4-3/3       |
| Direct Cost |                                     |                     |                      |                |             |
| I - Works   |                                     |                     |                      |                |             |
|             | A - Preliminary                     | 380.00              | 309.17               | -70.83         | -18.64%     |
|             | B - Land                            | 150.00              | 150.00               | -              | -           |
|             | C - Civil Works                     |                     |                      |                |             |
|             | i. River care                       | 130.00              | -                    | -130.00        | -100.00%    |
|             | ii. Dam                             | 1,171.76            | 1248.64              | 76.88          | 6.56%       |
|             | iii. Intake                         | 1,066.13            | 843.34               | -222.79        | -20.90%     |
|             | iv. Hydro Mechanical                | 852.94              | 723.63               | -129.31        | -15.16%     |
|             | Sub-total – Civil Works             | 3,220.83            | 2815.61              | -405.22        | -12.58%     |
|             | J - Power Plant Civil Works         |                     |                      |                |             |
|             | i. Head race tunnel                 | 874.49              | 818.21               | -56.28         | -6.44%      |
|             | ii. Surge shaft                     | 745.27              | 487.05               | -258.22        | -34.65%     |
|             | iii. Pressure shaft / Penstock      | 422.58              | 722.46               | 299.88         | 70.96%      |
|             | iv. Power house complex             | 2,141.16            | 2367.38              | 226.22         | 10.57%      |
|             | v. Tail race tunnel                 | 1,001.29            | 1042.11              | 40.82          | 4.08%       |
|             | vi. Switchyard                      | 208.90              | 179.99               | -28.91         | -13.84%     |
|             | vii. Hydro mechanical works         | 227.68              | 185.57               | -42.11         | -18.50%     |
|             | Sub Total - J - Works               | 5,628.37            | 5802.77              | 174.4          | 3.10%       |
|             | K - Building                        | 695.07              | 477.48               | -217.59        | -31.30%     |
|             | M - Plantation                      | 14.00               | 14.00                | -              | -           |
|             | O - Miscellaneous                   | 449.00              | 264.00               | -185.00        | -41.20%     |
|             | P - Maintenance during Construction | 102.92              | 95.13                | -7.79          | -7.57%      |
|             | Q - Special T & P                   | 129.14              | 59.13                | -70.01         | -54.21%     |
|             | R - Communication                   | 205.00              | 416.84               | 211.84         | 103.34%     |

| Item          | Major Scope of Work                             | DPR Cost<br>(Mar 2005) | Approved<br>Cost (2008) | Cost<br>Variation | %<br>Variation |
|---------------|---|------------------------|-------------------------|-------------------|----------------|
| 1             | 2   | 3                      | 4                       | 4-3               | 4-3/3          |
|               | X - Environment & Ecology                       | 80.00                  | 30.00                   | -50.00            | -62.50%        |
|               | Y - Losses on stock                             | 26.24                  | 23.78                   | -2.46             | -9.37%         |
|               | II. Establishment                               | 690.67                 | 618.47                  | -72.20            | -10.45%        |
|               | III. Tools and Plants                           | 115.08                 | 50.00                   | -65.08            | -56.55%        |
|               | IV. Suspense                                    | -                      | -                       |                   |                |
|               | V. Receipt and Recoveries                       | (78.55)                | (60.97)                 | 17.58             | -22.38%        |
| Indirect Cost |   |                        |                         |                   |                |
|               | a). Capitalisation of Abatement of Land Revenue | 110.80                 | -                       | -110.80           | -100.00%       |
|               | b). Audit and Account Charges                   | -                      | 52.29                   | 52.29             | -              |
|               | Total of Civil Works                            | 12,091.67              | 11,117.70               | -973.97           | -8.05%         |

The comparison of the cost of civil works between the revised DPR and corrected Approved costs is shown in Table 5. Comparison between the approved cost and cost estimate as per DPR reveals that an amount of INR 1.10 crore towards the head *Capitalized Value of Abatement of Cost of Land Revenue* has not been taken into consideration in the approved cost while the provision under the head *Audit & Account Charges* (INR 52.29 lakhs) has been set aside in the approved cost. From Table 5, it could be observed that the provisions under all the item heads excluding *R – Communication* were reduced while vetting the civil work project cost. The major portion of the deduction has been with respect to items such as *C – Civil Works*, *K – Building*, and *O – Miscellaneous*. While, provisions under item heads such as *B – Land*, and *M – Plantation* have remained unchanged but item such as *Capitalisation of Abatement of Land Revenue* has been completely ignored while vetting the Project Cost – Civil Works. *Audit and Account Charges* have been taken into account in the vetted Project Cost, which was not accounted for in the estimated cost of DPR. On the other hand, it could be observed from Table 5 that cost provisions against all the item heads have been reduced in the approved cost. However, the cost provisions for items such as *Dam*, *HRT*, *TRT*, and *Surge Shaft* have been increased marginally.

Table 5 Civil Works – Comparison of DPR Cost and Approved Cost as per Consultant's Computation

All cost figures in INR Lakhs

| Item                        | Major Scope of Work       | DPR Cost<br>(Mar 2005) | Approved<br>Cost (2008) | Cost<br>Variation | %<br>Variation |
|-----------------------------|---------------------------|------------------------|-------------------------|-------------------|----------------|
| 1                           | 2                         | 3                      | 4                       | 4-3               | 4-3/3          |
| Direct Cost                 |                           |                        |                         |                   |                |
| I - Works                   |                           |                        |                         |                   |                |
|                             | A - Preliminary           | 440.00                 | 309.17                  | (130.83)          | -29.73%        |
|                             | B - Land                  | 150.00                 | 150.00                  | -                 | -              |
| C - Civil Works             |                           |                        |                         |                   |                |
| i.                          | River care                | 130.00                 | -                       | (130.00)          | -100.00%       |
| ii.                         | Dam                       | 1,171.52               | 1,248.64                | 77.12             | 6.58%          |
| iii.                        | Intake                    | 1,066.15               | 926.37                  | (139.78)          | -13.11%        |
| iv.                         | Hydro Mechanical          | 852.73                 | 723.64                  | (129.10)          | -15.14%        |
|                             | Sub-total – Civil Works   | 3,220.41               | 2,898.65                | (321.76)          | -9.99%         |
| J - Power Plant Civil Works |                           |                        |                         |                   |                |
| i.                          | Head race tunnel          | 784.12                 | 818.22                  | 34.10             | 4.35%          |
| ii.                         | Surge shaft               | 422.59                 | 473.23                  | 50.64             | 11.98%         |
| iii.                        | Pressure shaft / Penstock | 748.18                 | 722.46                  | (25.72)           | -3.44%         |
| iv.                         | Power house complex       | 2,598.51               | 2,484.82                | (113.69)          | -4.38%         |
| v.                          | Tail race tunnel          | 1,001.29               | 1,042.08                | 40.79             | 4.07%          |
| vi.                         | Switchyard                | 208.92                 | 179.99                  | (28.93)           | -13.85%        |

| Item          | Major Scope of Work                             | DPR Cost<br>(Mar 2005) | Approved<br>Cost (2008) | Cost<br>Variation | %<br>Variation |
|---------------|---|------------------------|-------------------------|-------------------|----------------|
| 1             | 2   | 3                      | 4                       | 4-3               | 4-3/3          |
|               | vii. Hydro mechanical works                     | 220.50                 | 185.58                  | (34.93)           | -15.84%        |
|               | Sub Total - J - Works                           | 5,984.11               | 5,906.37                | (77.74)           | -1.30%         |
|               | K - Building                                    | 704.07                 | 477.45                  | (226.63)          | -32.19%        |
|               | M - Plantation                                  | 13.80                  | 13.80                   | -                 | 0.00%          |
|               | O - Miscellaneous                               | 449.00                 | 264.00                  | (185.00)          | -41.20%        |
|               | P - Maintenance during Construction             | 106.56                 | 100.32                  | (6.24)            | -5.86%         |
|               | Q - Special T & P                               | 129.14                 | 82.25                   | (46.89)           | -36.31%        |
|               | R - Communication                               | 205.00                 | 416.84                  | 211.84            | 103.34%        |
|               | X - Environment & Ecology                       | 80.00                  | 55.00                   | (25.00)           | -31.25%        |
|               | Y - Losses on stock                             | 26.24                  | 24.37                   | (1.87)            | -7.13%         |
|               | II. Establishment                               | 690.67                 | 650.86                  | (39.81)           | -5.76%         |
|               | III. Tools and Plants                           | 115.08                 | 106.98                  | (8.10)            | -7.04%         |
|               | IV. Suspense                                    | -                      | -                       | -                 | -              |
|               | V. Receipt and Recoveries                       | (78.55)                | (60.96)                 | (17.59)           | -22.39%        |
| Indirect Cost |   |                        |                         |                   |                |
|               | a). Capitalisation of Abatement of Land Revenue | 110.80                 | -                       | (110.80)          | -100.00%       |
|               | b). Audit and Account Charges                   | -                      | 52.29                   | 52.29             | -              |
|               | Total of Civil Works                            | 12,346.34              | 11,447.39               | (898.95)          | -7.28%         |

### Electro-Mechanical Works

The Electrical Works for the project has been approved at a cost of INR 6,095 lakhs, as per the records, while this cost has been computed to be around INR 6,148 lakhs. The increase in the computed cost, of about INR 53.87 lakhs, is due to taking into consideration the provision of *Maintenance during Construction @ 1% on items 2 & 3 except Erection and Commissioning Charges*. Provision towards the above-mentioned head is around INR 50.82 lakhs in the consultant's model.

Table 6 Electrical Works – Comparison of Approved Costs as per Records and Present Cost Model

| Sl. No. | Item  | Approved Cost  |                    | Cost Variation | % Variation |
|---------|---|----------------|--------------------|----------------|-------------|
|         |   | As per Records | As per Calculation |                |             |
| 1       | 2   | 3              | 4                  | 4-3            | 4-3/3       |
| 1       | Preliminary   | 135.00         | 135.00             | -              | -%          |
| 2       | Generating Plant and Equipment  |                |                    |                |             |
|         | a Generator, Turbine and Accessories                                      | 2,848.64       | 2,848.64           | -              | -           |
|         | b Auxiliary electrical equipment for power station                        | 1,131.32       | 1,131.32           | -              | -           |
|         | c Auxiliary equipment and services for power station                      | 437.48         | 437.48             | -              | -           |
|         | d Central Sales Tax   | 132.52         | 132.51             | -0.01          | -0.01%      |
|         | e Transportation, Handling and Insurance charges @ 6% of 2(a), (b), (c)   | 265.05         | 265.02             | -0.03          | -0.01%      |
|         | f Erection and commissioning charges @ 8% of 2(a), (b), & (c) less Spares | 350.23         | 350.2              | -0.03          | -0.01%      |
|         | Total Generating Plant and Equipment                                      | 5,165.24       | 5,164.77           | -0.47          | -0.01%      |
| 3       | a Substation equipment and auxiliary equipment for switchyard             | 247.48         | 245.00             | -2.48          | -1.00%      |
|         | b Central sales tax   | 9.90           | 7.35               | -2.55          | -25.76%     |

| Sl. No. | Item  | Approved Cost   |                    | Cost Variation | % Variation   |
|---------|---|-----------------|--------------------|----------------|---------------|
|         |   | As per Records  | As per Calculation |                |               |
| 1       | 2   | 3               | 4                  | 4-3            | 4-3/3         |
| c       | Transportation, handling and insurance charges @8% of 3 (a) less spares                       | 14.85           | 14.70              | -0.15          | -1.01%        |
| d       | Erection and commissioning charges @8% of 3(a) less spares                                    | 19.36           | 19.11              | -0.25          | -1.29%        |
|         | <i>Total (Sub-station equipment and auxiliary equipment and service of switchyard)</i>        | <i>291.59</i>   | <i>286.16</i>      | <i>-5.43</i>   | <i>-1.86%</i> |
| 4       | Losses on stock @0.25% on items 2 & 3 except erection and commissioning charges               | 12.71           | 12.71              | -              | -             |
| 5       | Maintenance during construction @ 1% on items 2 & 3 except erection and commissioning charges | -               | 50.82              | 50.82          | -             |
| 6       | Procurement and inspection charges @2% of items 2&3 except erection and commissioning charges | -               | -                  | -              | -             |
| 7       | Contingencies @ 1% in items 2&3   | 54.51           | 54.51              | -              | -             |
| 7       | Contingencies @ 3% in items 2&3   | -               | -                  | -              | -             |
| 8       | Total (Item 1 to 7)   | 5,653.62        | 5,703.96           | 50.34          | 0.89%         |
| 9       | Establishment @ 6% of item 8  | 339.22          | 342.24             | 3.02           | 0.89%         |
| 10      | T&P   | 28.27           | 28.52              | 0.25           | 0.88%         |
| 11      | Audit & Account Charges   | 28.27           | 28.52              | 0.25           | 0.88%         |
| 12      | Service tax @ 14.50% on erection and commissioning  | 45.65           | 45.65              | -              | -             |
|         | <b>Total of E&amp;M Works</b>   | <b>6,095.02</b> | <b>6,148.89</b>    | <b>53.87</b>   | <b>0.88%</b>  |

The comparison of the cost of *Electrical Works* as per the DPR and the cost approved by the competent authority is shown in Table 7. The comparison is based on the costs obtained from the records. It could be observed that approved cost has reduced to INR 6,095 lakhs from the estimated cost of INR 7,337 lakhs. The major portion of the difference between the two costs is relating to the cost of *Generator, Turbine and Accessories*. The reason for this difference could be attributed to the lack of provision towards *Butterfly Valve (2.7 m dia)* in the *Approved Cost*. Another reason for the difference is that, in the approved cost, provisions towards *Maintenance during Construction*, and *Procurement and Inspection Charges* are not provided in the *Approved Cost*. Lastly, the comparison of the corrected costs of *Electrical Works* as per the *DPR* and *Approved Cost* is shown in Table 8. The difference between these two costs are almost similar to the difference observed earlier, however the costs towards both the *DPR* and *Approved costs* have increased, as per the consultant's estimates.

Table 7 E&M Works – Comparison of DPR Costs and Approved Costs as per Records

| All cost figures in INR Lakhs |  |                     |                      |                |             |
|-------------------------------|--|---------------------|----------------------|----------------|-------------|
| Sl. No.                       | Item   | DPR Cost (Mar 2005) | Approved Cost (2008) | Cost Variation | % Variation |
| 1                             | 2  | 3                   | 4                    | 4-3            | 4-3/3       |
| 1                             | Preliminary  | 215.00              | 135.00               | (80.00)        | -37.21%     |
| 2                             | Generating Plant and Equipment                     |                     |                      |                |             |
| a                             | Generator, Turbine and Accessories                 | 3,499.64            | 2,848.64             | -651.00        | -18.60%     |
| b                             | Auxiliary electrical equipment for power station   | 1,166.69            | 1,131.32             | -35.37         | -3.03%      |
| c                             | Auxiliary equipment and services for power station | 367.08              | 437.48               | 70.40          | 19.18%      |



| Sl. No. | Item  | DPR Cost (Mar 2005) | Approved Cost (2008) | Cost Variation   | % Variation    |
|---------|---|---------------------|----------------------|------------------|----------------|
| 1       | 2   | 3                   | 4                    | 4-3              | 4-3/3          |
| d       | Central Sales Tax   | 201.34              | 132.52               | -68.82           | -34.18%        |
| e       | Transportation, Handling and Insurance charges @ 6% of 2(a), (b), (c)                         | 302.00              | 265.05               | -36.95           | -12.24%        |
| f       | Erection and commissioning charges @ 8% of 2(a), (b), & (c) less Spares                       | 376.09              | 350.23               | -25.86           | -6.88%         |
|         | <b>Total Generating Plant and Equipment</b>   | <b>5,912.84</b>     | <b>5,165.24</b>      | <b>-747.60</b>   | <b>-12.64%</b> |
| 3 a     | Substation equipment and auxiliary equipment for switchyard                                   | 247.48              | 245.00               | -2.48            | -1.00%         |
| b       | Central sales tax   | 9.90                | 7.35                 | -2.55            | -25.76%        |
| c       | Transportation, handling and insurance charges @8% of 3 (a) less spares                       | 14.85               | 14.70                | -0.15            | -1.01%         |
| d       | Erection and commissioning charges @8% of 3(a) less spares                                    | 19.36               | 19.11                | -0.25            | -1.29%         |
|         | <b>Total (Sub-station equipment and auxiliary equipment and service of switchyard)</b>        | <b>291.59</b>       | <b>286.16</b>        | <b>-5.43</b>     | <b>-1.86%</b>  |
| 4       | Losses on stock @0.25% on items 2 & 3 except erection and commissioning charges               | 14.52               | 12.71                | -1.81            | -12.47%        |
| 5       | Maintenance during construction @ 1% on items 2 & 3 except erection and commissioning charges | 58.09               | -                    | -58.09           | -100.00%       |
| 6       | Procurement and inspection charges @2% of items 2&3 except erection and commissioning charges | 116.18              | -                    | -116.18          | -100.00%       |
| 7       | Contingencies @ 1% in items 2&3   | -                   | 54.51                | 54.51            | -              |
| 7       | Contingencies @ 3% in items 2&3   | 186.13              | -                    | -186.13          | -100.00%       |
| 8       | Total (Item 1 to 7)   | 6,794.35            | 5,653.62             | -1,140.73        | -16.79%        |
| 9       | Establishment @ 6% of item 8  | 407.66              | 339.22               | -68.44           | -16.79%        |
| 10      | T&P   | 67.94               | 28.27                | -39.68           | -58.39%        |
| 11      | Audit & Account Charges   | 67.94               | 28.27                | -39.68           | -58.39%        |
| 12      | Service tax @ 14.50% on erection and commissioning  |                     | 45.65                | 45.65            | -              |
|         | <b>Total of E&amp;M Works</b>   | <b>7,337.90</b>     | <b>6,095.02</b>      | <b>-1,242.88</b> | <b>-16.94%</b> |

Table 8 E&M Works – Comparison of DPR and Approved Costs as per Study Cost Model

All cost figures in INR Lakhs

| Sl. No. | Item  | DPR Cost (Mar 2005) | Approved Cost (2008) | Cost Variation  | % Variation    |
|---------|---|---------------------|----------------------|-----------------|----------------|
| 1       | 2   | 3                   | 4                    | 4-3             | 4-3/3          |
| 1       | Preliminary   | 215.00              | 135.00               | (80.00)         | -37.21%        |
| 2       | Generating Plant and Equipment  |                     |                      |                 |                |
| a       | Generator, Turbine and Accessories                                      | 3,499.64            | 2,848.64             | (651.41)        | -18.61%        |
| b       | Auxiliary electrical equipment for power station                        | 1,154.29            | 1,131.32             | (22.97)         | -1.99%         |
| c       | Auxiliary equipment and services for power station                      | 367.08              | 437.48               | 70.40           | 19.18%         |
| d       | Central Sales Tax   | 200.84              | 132.51               | (68.33)         | -34.02%        |
| e       | Transportation, Handling and Insurance charges @ 6% of 2(a), (b), (c)   | 301.26              | 265.02               | (36.24)         | -12.03%        |
| f       | Erection and commissioning charges @ 8% of 2(a), (b), & (c) less Spares | 398.30              | 350.20               | (48.10)         | -12.08%        |
|         | <b>Total Generating Plant and Equipment</b>                             | <b>5,921.42</b>     | <b>5,164.77</b>      | <b>(756.65)</b> | <b>-12.78%</b> |
| 3 a     | Substation equipment and auxiliary equipment for switchyard             | 244.48              | 245.00               | 0.52            | 0.21%          |

| Sl. No. | Item  | DPR Cost (Mar 2005) | Approved Cost (2008) | Cost Variation    | % Variation    |
|---------|---|---------------------|----------------------|-------------------|----------------|
| 1       | 2   | 3                   | 4                    | 4-3               | 4-3/3          |
| b       | Central sales tax   | 9.78                | 7.35                 | (2.43)            | -24.84%        |
| c       | Transportation, handling and insurance charges @8% of 3 (a) less spares                       | 14.67               | 14.70                | 0.03              | 0.21%          |
| d       | Erection and commissioning charges @8% of 3(a) less spares                                    | 19.12               | 19.11                | (0.01)            | -0.03%         |
|         | <i>Total (Sub-station equipment and auxiliary equipment and service of switchyard)</i>        | <i>288.04</i>       | <i>286.16</i>        | <i>(1.88)</i>     | <i>-0.65%</i>  |
| 4       | Losses on stock @0.25% on items 2 & 3 except erection and commissioning charges               | 14.48               | 12.71                | (1.78)            | -12.27%        |
| 5       | Maintenance during construction @ 1% on items 2 & 3 except erection and commissioning charges | 57.92               | 50.82                | (7.10)            | -12.27%        |
| 6       | Procurement and inspection charges @2% of items 2&3 except erection and commissioning charges | 115.84              | -                    | (115.84)          | -100.00%       |
| 7       | Contingencies @ 1% in items 2&3   | -                   | 54.51                | 54.51             |                |
| 7       | Contingencies @ 3% in items 2&3   | 186.13              | -                    | (186.28)          | -100.00%       |
| 8       | Total (Item 1 to 7)   | 6,798.99            | 5,703.96             | (1,095.03)        | -16.11%        |
| 9       | Establishment @ 6% of item 8  | 407.66              | 342.24               | (65.70)           | -16.11%        |
| 10      | T&P   | 67.99               | 28.52                | (39.47)           | -58.05%        |
| 11      | Audit & Account Charges   | 67.99               | 28.52                | (39.47)           | -58.05%        |
| 12      | Service tax @ 14.50% on erection and commissioning  |                     | 45.65                | 45.65             | -              |
|         | <b>Total of E&amp;M Works</b>   | <b>7,342.91</b>     | <b>6,148.89</b>      | <b>(1,194.02)</b> | <b>-16.26%</b> |

## Actual Project Cost

The actual cost of the project has been estimated by accounting for all the payments made to the concerned contractors for the civil works and electro-mechanical works till March 31<sup>st</sup>, 2019. Table 10 shows the actual cost of the civil works paid till March 31<sup>st</sup>, 2019. The actual cost of the *Civil Works* has been found to be INR 29,437 lakhs, highlighting an increase of about 157% from the actual cost. While, the expenditures towards the *Electrical Works* has increased from INR 6,148.89 lakhs to INR 11,663.66 lakhs, indicating an increase of 89.68%.

Table 9 Summary of the Total Project Cost as on March 31, 2019

| Sl. No | Major Cost Head              | Approved Cost | Actual Cost | Cost Variation | % Variation |
|--------|------------------------------|---------------|-------------|----------------|-------------|
| 1      | Civil Works                  | 11,447.39     | 29,437.26   | 17,990.53      | 157.16%     |
| 2      | Electro-Mechanical Works     | 6,148.89      | 11,663.66   | 5,514.77       | 89.68%      |
| 3      | Prepayment Charges           | -             | 308.95      | 308.95         | -           |
| 4      | Interest During Construction | -             | 17,329.92   | 17,329.92      | -           |
| 5      | Total                        | 17,596.28     | 58,739.79   | 41,143.51      | 233.82%     |

## Civil Works

The comparison of the expenditures towards Civil Works with the approved cost is shown in Table 10. It could be observed that expenditures on all the heads, except *B - Land*, *M - Plantation*, *P - Maintenance during Construction*, *Q - Special T&P*, *Y - Losses on Stock*, *III - Tools and Plants*, and *V - Receipts and Recoveries*, have increased. The highest increase in

actual cost in comparison with the approved cost is relating to the cost head *C – Civil Works* and, under this cost head, highest increase in cost could be observed relating to work item *Dam*. Relating to cost head *J – Power Plant Civil Works*, the highest increase in cost could be observed relating to the work item *Head Race Tunnel*.

*Table 10 Comparison of Costs of Civil Works – Approved Cost and Actual Cost as per Computation*

All cost figures in INR Lakhs

| Item                 | Major Scope of Work                             | Approved Cost (2008) | Actual Cost (March' 19) | Cost Variation | % Variation |
|----------------------|---|----------------------|-------------------------|----------------|-------------|
| 1                    | 2   | 3                    | 4                       | 4-3            | 4-3/3       |
| <b>Direct Cost</b>   |   |                      |                         |                |             |
| <b>I - Works</b>     |   |                      |                         |                |             |
|                      | A - Preliminary                                 | 309.17               | 602.57                  | 293.40         | 94.90%      |
|                      | B - Land  | 150.00               | 33.96                   | (116.04)       | -77.36%     |
|                      | C - Civil Works                                 |                      |                         |                |             |
|                      | i. River care                                   | -                    | -                       | -              |             |
|                      | ii. Dam   | 1,248.64             | 8,041.21                | 6,792.57       | 544.00%     |
|                      | iii. Intake                                     | 926.37               | 1,593.98                | 667.61         | 72.07%      |
|                      | iv. Hydro mechanical works                      | 723.64               | 1,308.29                | 584.65         | 80.79%      |
|                      | Sub-total – Civil Works                         | 2,898.65             | 10,943.47               | 8,044.82       | 277.54%     |
|                      | J - Power Plant Civil Works                     |                      |                         |                |             |
|                      | i. Head race tunnel                             | 818.22               | 3,043.97                | 2,225.75       | 272.03%     |
|                      | ii. Surge shaft                                 | 473.23               | 1,280.24                | 807.02         | 170.53%     |
|                      | iii. Pressure shaft / Penstock                  | 722.46               | 1,271.40                | 548.94         | 75.98%      |
|                      | iv. Power house complex                         | 2,484.82             | 4,319.10                | 1,834.29       | 73.82%      |
|                      | v. Tail race tunnel                             | 1,042.08             | 2,036.33                | 994.25         | 95.41%      |
|                      | vi. Switchyard                                  | 179.99               | 409.97                  | 229.98         | 127.78%     |
|                      | vii. Hydro mechanical works                     | 185.58               | 567.83                  | 382.25         | 205.98%     |
|                      | Sub Total - J - Works                           | 5,906.37             | 12,928.85               | 7,022.48       | 118.90%     |
|                      | K - Building                                    | 477.45               | 551.60                  | 74.16          | 15.53%      |
|                      | M - Plantation                                  | 13.80                | 8.63                    | (5.18)         | -37.50%     |
|                      | O - Miscellaneous                               | 264.00               | 269.10                  | 5.10           | 1.93%       |
|                      | P - Maintenance during Construction             | 100.32               | 63.95                   | (36.38)        | -36.26%     |
|                      | Q - Special T & P                               | 82.25                | 39.74                   | (42.51)        | -51.68%     |
|                      | R - Communication                               | 416.84               | 863.05                  | 446.21         | 107.05%     |
|                      | X - Environment & Ecology                       | 55.00                | 105.68                  | 50.68          | 92.14%      |
|                      | Y - Losses on stock                             | 24.37                | -                       | (24.37)        | 100.00%     |
|                      | II. Establishment                               | 650.86               | 2,956.67                | 2,305.81       | 146.87%     |
|                      | III. Tools and Plants                           | 106.98               | 46.99                   | (59.99)        | 354.27%     |
|                      | IV. Suspense                                    | -                    | -                       | -              | -56.08%     |
|                      | V. Receipt and Recoveries                       | (60.96)              | -                       | (60.96)        | 100.00%     |
| <b>Indirect Cost</b> |   |                      |                         |                |             |
|                      | a). Capitalisation of Abatement of Land Revenue | -                    | -                       | -              | -           |
|                      | b). Audit and Account Charges                   | 52.29                | 23.66                   | (28.63)        | -54.76%     |
|                      | Total of Civil Works                            | 11,447.39            | 29,437.26               | 17,990.53      | 157.16%     |

## Electro-Mechanical Works

The actual cost incurred towards the Electro-Mechanical Works is INR 11,663.66 lakhs. The summary of the various expenses towards Electrical Works is shown in Table 11. With respect to both the two major heads – *Generating Plant and Equipment* and *Substation Equipment and Auxillary Equipment for Switchyard*, the expenditures towards *Transportation, Handling and Insurance Charges*; and *Erection and Commissioning Charges*

have been included in the cost of the major heads itself. The cost of the *Generating Plant and Equipment* is even inclusive of the cost of *Auxillary Electrical Equipment for Power Station* and *Auxillary Equipment and Services for Power Station*. It could be observed from the comparison of the actual cost with the approved cost that actual expenditures have increased by about 89%, when compared with the approved cost. The highest portion of the increase in terms of percentage under both the major heads is with respect to the provision under *Central Sales Tax*. And, with respect to both the heads, the increase in cost is higher with respect to cost head *Substation Equipment and Auxillary Equipment for Switchyard*. The expenses towards the head *Audit and Account Charges* have already been booked under the same head in *Civil Works*.

*Table 11 Comparison of Costs of Electrical Works – Approved Cost and Actual Cost as per Computation*

| All cost figures in INR Lakhs   |   |                      |                         |                 |               |
|---------------------------------|---|----------------------|-------------------------|-----------------|---------------|
| Sl. No.                         | Item  | Approved Cost (2008) | Actual Cost (March' 19) | Cost Variation  | % Variation   |
| 1                               | Preliminary   | 135.00               | 241.49                  | 106.49          | 78.88%        |
| 2                               | Generating Plant and Equipment  |                      |                         |                 |               |
| a                               | Generator, Turbine and Accessories  | 5,150.29             | 8,135.74                | 2,985.45        | 57.97%        |
| b                               | Auxillary electrical equipment for power station  | -                    | -                       | -               | -             |
| c                               | Auxillary equipment and services for power station  | -                    | -                       | -               | -             |
| d                               | Central Sales Tax @ 4% on 2(a) , (b) & ©  | 132.51               | 815.60                  | 683.09          | 515.49%       |
| e                               | Transportation, Handling and Insurance charges @ 6% of 2(a), (b), (c)                         | -                    | -                       | -               | -             |
| f                               | Erection and commissioning charges @ 8% of 2(a), (b), & (c) less Spares                       | -                    | -                       | -               | -             |
|                                 | Total Generating Plant and Equipment  | 5,282.80             | 8,951.34                | 3,668.54        | 69.44%        |
| 3                               | a Substation equipment and auxillary equipment for switchyard                                 | 278.81               | 1,402.12                | 1,123.31        | 402.89%       |
| b                               | Central sales tax @ 4% of 3 (a)   | 7.35                 | 102.25                  | 94.90           | 1291.22%      |
| c                               | Transportation, handling and insurance charges @8% of 3 (a) less spares                       | -                    | -                       | -               | -             |
| d                               | Erection and commissioning charges @8% of 3(a) less spares                                    | -                    | -                       | -               | -             |
|                                 | Total (Sub-station equipment and auxillary equipment and service of switch yard)              | 286.16               | 1,504.38                | 1,218.21        | 425.71%       |
| 4                               | Losses on stock @0.25% on items 2 & 3 except erection and commissioning charges               | -                    | -                       | -               | -             |
| 5                               | Maintenance during construction @ 1% on items 2 & 3 except erection and commissioning charges | -                    | -                       | -               | -             |
| 6                               | Procurement and inspection charges @2% of items 2&3 except erection and commissioning charges | -                    | -                       | -               | -             |
| 7                               | Contingencies @ 3% in items 2&3   | -                    | -                       | -               | -             |
| 8                               | Total (Item 1 to 7)   | 5,703.96             | 10,697.21               | 4,993.24        | 87.54%        |
| 9                               | Establishment @ 6% of item 8  | 342.24               | -                       | (342.24)        | -100.00%      |
| 10                              | T&P @ 1% on item 8  | 28.52                | 29.34                   | 0.82            | 2.88%         |
| 11                              | Audit & Account Charges @ 1% of item 8  | 28.52                | -                       | (28.52)         | -100.00%      |
| 12                              | Service tax @ 14.50% on erection and commissioning  | 45.65                | -                       | (45.65)         | -100.00%      |
| 13                              | Insurance, Bank Charges and Warranty Extension  | -                    | 937.11                  | 937.11          | -             |
| <b>Total – Electrical Works</b> |   | <b>6,148.89</b>      | <b>11,663.66</b>        | <b>5,514.77</b> | <b>89.69%</b> |

## Civil Works – Analysis of Expenses

Normally, as per the CWC (1997) and CEA (2015) guidelines, the provision towards *A - Preliminary* should be @1 – 2% of the total cost of *I - Works*. The expenses incurred towards this head is INR 602.57 lakhs (Table 12). Considering the cost of *I – Works* as INR 26,410.60 lakhs, it could be observed that the expenditure towards this head is slightly beyond this norm (approximately about 2.28% of the cost of *I - Works*).

Table 12 Summary of Expenses Incurred Towards the Head A - Preliminary

| Sl. No. | Item  | Expenses (in INR Lakhs) |
|---------|---|-------------------------|
| 1       | Consultancy charges   | 289.01                  |
| 2       | Geological studies/Hydrological/Metrological studies/Drilling works   | 80.62                   |
| 3       | Surveys for final location, Construction of access roads to facilitate investigation, and other related works | 154.62                  |
| 4       | Office stationeries and other related items   | 78.31                   |
|         | Total   | 602.57                  |

For the head relating to *K - Buildings*, as per the CWC (1997), the provision for the cost of buildings in hilly region could be estimated @ 6% – 8% of the cost of *I - Works*. Table 13 shows the summary of the expenditures incurred towards the cost head *K – Buildings*. An amount of INR 490.30 lakhs have been incurred towards this head. Major portion of the expenses have been incurred towards the construction of residential buildings and guest house for staff and officers. The various items chargeable to buildings include expenses towards construction of fencing walls, retaining walls, and land development/levelling. It could be observed that the expenses towards this head is well within the norms, i.e. 2.09% of the cost of *I – Works*.

Table 13 Summary of Expenses Incurred Towards the Cost Head K - Buildings

| Sl. No. | Item                                | Expenditure (in INR Lakhs) |
|---------|-------------------------------------|----------------------------|
| 1       | Residential buildings               | 305.10                     |
| 2       | Non-residential buildings           | 121.62                     |
| 3       | Other items chargeable to buildings | 124.88                     |
|         | Total                               | 551.60                     |

The summary of the expenses incurred towards the cost head *O - Miscellaneous* is INR 269.10 lakhs (Table 14). It could be observed from Table 14 that major portion of the expenses under this cost head is incurred relating to publications, labour registration, maintenance of office equipment and visit of dignitaries and running of inspection bungalow. With respect to this cost head *O - Miscellaneous*, provision under this head as per CWC (1997) has been set at 4% of cost of *I – Works*, while as per CEA (2015), the provision should not exceed @3% of cost of *I - Works* up to INR 1,000 crores limited to INR 20 crores. The expenses under this cost head is around 1.02% of the cost of *I – Works*, thereby highlighting the fact that these expenses within the norms.

Table 14 Summary of Expenses Incurred Towards the Cost Head O - Miscellaneous

| Sl. No. | Item   | Expenses (in INR Lakhs) |
|---------|--|-------------------------|
| 1       | Capital cost of water supply/sewage disposal/recreational facilities   | 87.55                   |
| 2       | Maintenance and service of vehicles/security arrangements/water supply/sewage disposal   | 27.23                   |
| 3       | Other items such as publications, pamphlets, labour registration, visits of dignitaries, running of inspection bungalow, maintenance of office equipment | 154.32                  |
|         | Total  | 269.10                  |

The summary of the expenses incurred towards the cost head *P - Maintenance* is INR 63.95 lakhs (Table 15). It could be observed from Table 15 that the expenses under this cost head is incurred relating to maintenance of buildings, roads, drains, and other structures. Under this head, major portion of expenses towards maintenance is incurred in maintenance of buildings. With respect to cost head *P - Maintenance*, the provision as per CWC (1997) should be 1% of the cost of *I - Works* less costs under heads *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P* and *X - Environment* while as per CEA (2015), the provision under this head should be set at 1% of the total cost under heads of *C - Works*, *J - Power House*, and *K - Buildings*. With respect to both these norms, the provision towards the item *P - Maintenance* is around 0.25% and 0.26% relating to the respective norms of CWC (1997) and CEA (2015).

Table 15 Summary of Expenses Incurred Towards the Cost Head P - Maintenance

| Sl. No. | Item                            | Expenses (in INR Lakhs) |
|---------|---------------------------------|-------------------------|
| 1       | Maintenance of buildings        | 45.10                   |
| 2       | Maintenance of roads            | 14.12                   |
| 3       | Maintenance of drains           | 1.03                    |
| 4       | Maintenance of other structures | 3.70                    |
|         | Total                           | 63.95                   |

With respect to the provision against the cost head *Q - Special T&P*, the expenses incurred towards this head is INR 39.74 lakhs. The important items of equipment considered under this head were *water supply works and dewatering arrangements*, and *other transport vehicles*. As per the norms set by CEA (2015), a token amount of INR 200 lakhs can be provided under this head. The expenditures under this head is, therefore, within the norms set by CEA (2015).

Towards the cost head *R - Communication*, the expenses incurred till March 31, 2019 was INR 863.05 lakhs (Table 16). It could be observed that major portion of expenses has been incurred towards construction of main roads to various components of the dam, and other roads within the work area.

Table 16 Summary of Expenses Incurred towards the Cost Head R - Communication

| Sl. No. | Item                                  | Expenses (in INR Lakhs) |
|---------|---------------------------------------|-------------------------|
| 1       | Main roads to dam site                | 396.55                  |
| 2       | Roads and related works in works area | 327.59                  |
| 3       | Temporary /Permanent river crossings  | 69.76                   |
| 4       | Waterways                             | 69.15                   |
|         | Total                                 | 863.05                  |



With respect to the provision under the cost head *X – Environment and Ecology*, an amount of INR 105.58 lakhs have been incurred towards this head (Table 17). Major portion of the expenses can be categorised to be towards activities taken up for restoration of land in construction areas to prevent erosion and to provide healthy surroundings.

*Table 17 Summary of Expenses Incurred towards the Cost Head X - Environment and Ecology*

| Sl. No. | Item  | Expenses (in INR Lakhs) |
|---------|---|-------------------------|
| 1       | Compensatory afforestation                                      | -                       |
| 2       | Catchment area treatment  | -                       |
| 3       | Measures to salvage/rehabilitate any rare or endangered species | -                       |
| 4       | Public health measures  | 2.45                    |
| 5       | Restoration of land   | 88.29                   |
| 6       | Drainage in command area  | 14.84                   |
| 7       | Disaster management measures                                    | -                       |
|         | Total   | 105.58                  |

For the provision under cost head *Y - Losses on Stock*, the norm as per CWC (1997) is at 0.25% of cost of *I - Works* less costs under heads *A - Preliminary*, *B - Land*, *O - Miscellaneous*, *M - Plantation*, *Q - Special T&P* and *X - Environment* while as per CEA (2015), the provision under this head should be set at 0.25% of the total cost under heads of *C - Works*, *J - Power House*, and *K - Buildings*. However, it could be observed that no provision has been booked under this head in the actual expenses.

The provision under the cost head *II – Establishment* is towards leave pensionary charges, and the expenses for exercising proper control over construction costs. The expenses incurred under this head over the financial year starting from 2007-08 to 2018-19 is shown in Table 18. As per CWC (1997), the cost provision towards *II - Establishment* should be 8% to 10% of the cost of *I - Works* less the value of *B – Land*, while as per CEA (2015), it is set at 5% of the cost of *I - Works*. The cost provision towards *II - Establishment* following the methodology of CWC (1997) and CEA (2015) should be INR 2,637.60 lakhs and INR 1320.50 lakhs, respectively taking into consideration the actual expenses towards cost head *I – Works* and *B – Land*. The actual expenses under this head is, however, beyond the limits set by both the guidelines.

*Table 18 Summary of Expenses Incurred towards the Cost Head II - Establishment*

| Sl. No. | Financial Year | Establishment Cost (in INR Lakhs) |
|---------|----------------|-----------------------------------|
| 1       | 2007-08        | 174.13                            |
| 2       | 2008-09        | 48.14                             |
| 3       | 2009-10        | 87.12                             |
| 4       | 2010-11        | 155.61                            |
| 5       | 2011-12        | 226.40                            |
| 6       | 2012-13        | 284.15                            |
| 7       | 2013-14        | 292.95                            |
| 8       | 2014-15        | 294.89                            |
| 9       | 2015-16        | 534.43                            |
| 10      | 2016-17        | 291.95                            |
| 11      | 2017-18        | 338.23                            |
| 12      | 2018-19        | 228.68                            |
|         | Total          | 2,956.67                          |

The cost head *III – Tools & Plants* typically covers expenses for survey instruments, camp equipment, office equipment and other small tools. The expenditures incurred this head during the period 2008-09 to 2018-19 is INR 46.99 lakhs. Table 19 shows the expenditure incurred under this head on a year-wise basis. The expenditure incurred under this head is well within the guidelines set by both CWC (1997) and CEA (2015). As per CWC (1997) provision under this head should be 1% of the cost of *I – Works* less the cost of *Land*, whereas as per CEA (2015), it is recommended that a token provision of INR 1 – 2 crores under this head may be adequate. In accordance with this, the expenses under this head should be INR 230.14 lakhs and INR 1000 lakhs as per CWC (1997) and CEA (2015), respectively. The actual expenditure under this head, i.e. INR 46.99 lakhs, is well within the limit of both the provisions.

*Table 19 Summary of Expenses Incurred towards the Cost Head III - Tools & Plants*

| Sl. No. | Financial Year | Expenses (in INR Lakhs) |
|---------|----------------|-------------------------|
| 1       | 2008-09        | 16.96                   |
| 2       | 2009-10        | 2.00                    |
| 3       | 2010-11        | 3.21                    |
| 4       | 2011-12        | 10.82                   |
| 5       | 2012-13        | 4.00                    |
| 6       | 2013-14        | 5.62                    |
| 7       | 2014-15        | 0.13                    |
| 8       | 2015-16        | 0.01                    |
| 9       | 2016-17        | 0.93                    |
| 10      | 2017-18        | 0.75                    |
| 11      | 2018-19        | 2.56                    |
|         | Total          | 46.99                   |

With respect to cost head *V - Receipts & Recoveries*, receipts in the form of recoveries from resale or transfer of temporary buildings and special T&P, and rent charges of buildings are accounted under this head. However, no such recoveries have been taken into account in the actual cost of the project.

With respect to expenditure under the head *Capitalization of Abatement of Cost of Land Revenue*, no such expenses have been booked in the actual cost of the project. However, with respect to the other item under *Indirect Charges, i.e. Audit and Account Charges*, an amount of INR 23.92 lakhs has been incurred towards various charges relating to audit and account such as bank charges, stamp duties, taxes, preparation of TDS, audit and certification of project cost, and vetting of revised project cost. Table 20 shows the year-wise break-up of the expenses incurred under this head during the period 2008-09 to 2018-19. As per CWC (1997), the expenses under this head should be within 1% of the cost of *I – Works*. Under this norm, the expenses should be around INR 264.10 lakhs, considering the cost of *I – Works* to be INR 26,410 lakhs. The actual expenses, however, is well within the norm set by CWC (1997).

Table 20 Summary of Expenses Incurred towards the Cost Head - Audit & Account Charges

| Sl. No. | Financial Year | Expenses (in INR Lakhs) |
|---------|----------------|-------------------------|
| 1       | 2008-09        | 0.01                    |
| 2       | 2009-10        | 0.14                    |
| 3       | 2010-11        | 0.26                    |
| 4       | 2011-12        | 0.26                    |
| 5       | 2012-13        | 0.03                    |
| 6       | 2013-14        | 9.53                    |
| 7       | 2014-15        | 0.29                    |
| 8       | 2015-16        | 0.08                    |
| 9       | 2016-17        | 0.10                    |
| 10      | 2017-18        | 1.72                    |
| 11      | 2018-19        | 11.49                   |
|         | Total          | 23.92                   |

## Analysis of Cost Overrun

The expenses incurred towards the major cost head *I – Works* have been compared with the approved cost to understand the extent of cost overrun. Table 21 shows the result of the cost overrun analysis. It could be observed that difference between the actual cost and the approved cost is about INR 15,712 lakhs. The reason for the cost overrun could be attributed to four major factors – *Price Escalation*, *Change in Scope*, *Change in Design*, and *Over / Under Provision*. It could be observed from Table 21 that major portion of the cost overrun could be attributed to the factors *Change in Scope*, and *Change in Design*.

*Price Escalation*: Price escalation provision has been provided in the contract agreement to adjust the increase or decrease in the cost of labour, materials and High Speed Diesel. For price adjustment for labour, the All India Consumer Price Index with base year as 2001 has been used for adjusting the cost of work due to variation in labour wages. For materials such as cement and steel, the Wholesale Price Index for cement and steel with base year as 1993-94 has been used for adjusting the cost of work due to variation in prices of these materials. The proportion of cost attributable to labour, cement and steel has been set at 17.5%, 12% and 17.5% of the value of work done during the quarter. While the other materials such as fuel & lubricants, and other materials have been assumed to be about 8% and 5% of the value of the work done.

The increase in cost that could be attributed to variation in prices of labour and various construction materials is INR 3,541 lakhs. Out of this, major portion of the price variation has been with respect to the cost head *J – Power Plant Civil Works*. Price variation under this head is about INR 2,179 lakhs while with respect to *C – Civil Works* is about INR 1,362 lakhs. With respect to work items under these heads, the contractor has quoted a price of INR 2,017 lakhs for *C – Civil Works* and INR 5,915 lakhs for *J – Power Plant Civil Works*.

*Change in Scope and Change in Design*: Costs incurred the cost heads *C – Civil Works* and *J – Power Plant Civil Works* have incurred huge cost overruns due to change in scope and design. Cost overruns under these two heads could be attributed to multiple factors, discussed below.

- *Change in methodology*: One of the reasons is change in methodology for construction of the Dam. As per the original plan, it was proposed to use the original old masonry weir for the project. However, as per the CWC recommendation, it was instructed to construct a new dam instead of using the old masonry weir.

- *Change in design flood:* Design flood based on which the project was initially designed had to be increased from 2400 cumec to 3820 cumec. This had resulted in increasing the length of the spillway, thereby extending on to the non-overflow block in the right bank of the Old Umtru Project. This had, ultimately, resulted in the need for a larger size gates.
- *Increase in length of non-overflow block:* Length of the non-overflow block on the right bank of the dam had to be significantly increased from a geological standpoint. Similarly, extension of the left non-overflow block to the edge of the existing hillock had necessitated raising the ground level to elevation of 136.00 m. This had necessitated stabilization of downstream slope on the river side.
- *Shifting of the intake structure:* The intake structure had to be shifted to the dam portion. This had resulted in the need to extend the spillway to the right abutment. Shifting of the intake structure to the dam body also necessitated the construction of open RCC conduit of almost 160 m length to connect the intake to the HRT. Besides the need to change the design of the structure, additional excavation to an extent of 3m was also undertaken for the foundation of the conduit and filled the same with concrete. Shifting of the intake structure had also resulted in the need to extend the scouring sluice beyond the crossing below the RCC conduit, leading to further ancillary works.
- *Presence of shear zone:* Additional reinforcement works had to be undertaken on account of the presence of shear zone along the HRT alignment from chainage 113.00m to chainage 348.50m. Additional works in the form of provision of permanent steel supports along the alignment had to be undertaken along with the need for backfilling the same with concrete behind the lagging.
- *Poor geological conditions at site:* Additional ground improvement works had to be undertaken to take care of the poor geological conditions at the site. For instance, unstable geological conditions had been encountered along the TRT between chainage 0.00m to 450.75m. In order to stabilise the geological conditions, permanent steel support had to be provided throughout the whole stretch, along with concrete backfilling.
- *Change in project layout:* The configuration of the project layout had been changed with abolition of the unloading bay in the Power House and replacing it with an approach road on gradient to connect the service bay, resulting in change in scope of the project work. In addition to this, a channel had to be constructed at the TRT exit in order to streamline the flow parallel to the Umtru River in order to avoid erosion of the bank.
- *Revised Rates for increase in scope of the work:* As per the contract, in case of under-estimation of the quantity of a particular item of work and the actual quantum of work being carried out at the site is beyond 130% of the estimated quantity of work, then a new rate analysis should be carried out. And, the additional quantity of work being executed beyond the bill of quantities will need to be paid as per the new rates.

The cost implications of these factors on the various work items under the cost head *C – Civil Works* and *J – Power Plant Civil Works* are shown in Table 21. With respect to work item Dam under the cost head *C – Civil Works*, the quantum of the work had to be increased beyond the quantities specified in the bill of quantities for different grade of concrete laying,

consolidation and curing for NOF, Spillway Crest, Piers & Training Wall, Apron, and RCC Bridge over Overflow Blocks of Dam along with providing and fixing of reinforcement in the aforementioned items of works. Additional costs had to be incurred due to design change for Second Stage Concreting, Change in grade of concrete in NOF, OF, and Spillway Block and Piers. On account of increase in scope of work beyond 30% of the quantity notified in the bill of quantities, the increase in cost is around INR 28.69 lakhs. The implication of the change in construction methodology has resulted in the need to not execute some of the work items relating to raising of intake structure/scouring sluice walls and abutment works. And, the cost implication of this is non-execution of work amounting to INR 50.46 lakhs. On the other hand, due to design changes additional works had to be undertaken relating to drilling, grouting, concreting in NOF, OF, Spillway Block and Piers using new grade of concrete (M25). In addition to this, additional costs had to be incurred on account of second stage concreting and use of admixture and variation in cement content. This has resulted in an increase of INR 3371.72 lakhs.

With respect to work item – *Intake* under the cost head *C – Civil Works*, additional works had to be undertaken relating to concreting works using different grades of concrete such as M15 and M25, Second Stage Concreting, and use of admixture and variation in cement content. The cost implication of these is in the form of cost overrun of INR 1,162.64 lakhs. Finally, on account of the increase in scope of work beyond 30% for work item – Rock Bolting 25 mm dia, additional work of INR 17.23 lakhs was undertaken.

Relating to the work item – *HRT* under the cost head *J – Power Plant Civil Works*, extra works in tunnel lining using different grade of concrete such as M25, and backfilling had to be undertaken and this has an additional cost implication of INR 1221.34 lakhs. On the other hand, the cost implication of exceeding the scope of the work beyond 30% of the quantities specified in bill of quantities is about INR 788.08 lakhs. The key work items such as concrete portals, fixing and laying of reinforcement steel, structural steel for tunnel support, rock bolting, and grouting have exceeded the set limit as per the contract. Similar trend could also be observed in case of the work item – *Surge Shaft* under the cost head *J – Power Plant Civil Works*. Extra works in tunnel lining of the surge shaft using different grade of concrete such as M25, and backfilling had to be undertaken. In addition to this, additional costs had to be incurred on account of use of admixture and variation in cement content. These have resulted in an additional cost implication of INR 414.51 lakhs. Furthermore, increase in quantum of work beyond 30% of the quantities specified in bill of quantities in various works such as open excavation, underground tunnel excavation, rock bolting, structural steel works, and reinforcement steel fixing and laying have a cost implication of INR 180.25 lakhs.

With respect to the work item *Pressure Shaft* under the cost head *J – Power Plant Civil Works*, additional works had to be carried out relating to backfilling, and concreting in the overbreak area. Besides these, additional costs had to be incurred on account of use of admixture and variation in cement content in this work item also. This has resulted in an increase of cost by about INR 66.34 lakhs. Regarding the increase in quantum of work beyond the specified 30% in the bill of quantities, the additional cost implication of this is about INR 221.72 lakhs.

With respect to the work item *Power House Complex* under the cost head *J – Power Plant Civil Works*, the cost implication due to increase in quantities beyond the specified 30% of the bill of quantities is INR 1111.85 lakhs. The cost implication of design changes under this work item is INR 66.36 lakhs. Additional works that had to be undertaken are relating to provision of 0.8mm thick galvanised sheet, steel for cladding framework, concrete breaking, 2<sup>nd</sup> stage concreting, and use of admixture and variation in cement content in this work item. At the same time, some items of work had also been executed due to design changes and these works are drainage system, landscaping of power house complex, and insulation works.

With respect to *Tail Race Tunnel*, extra works had to be carried out due to change in geological conditions, resulting in the need to use higher grade concrete and additional backfilling works. On the other hand, some of the work items previously provisioned were not executed. The combined cost implication of this is about INR 406.38 lakhs. Furthermore, due to increase in quantum of works beyond the specified 30% for work items such as open excavation, underground tunnel excavation, precast concrete sleepers, structural steel works, drilling, and concrete grouting, the increase in the cost is about INR 6.87 lakhs.

Finally, regarding the work item *Switchyard* under the cost head *J – Power Plant Civil Works*, works in the form of additional concreting for storm water drains, backfilling behind power house and retaining wall had to be undertaken while concreting for foundations for switch yard was not executed. The net cost implication of these is an increase in cost by INR 80.78 lakhs.

*Over / Under Provision:* Over / under provision of various items of works under the two heads is either due to difference in the derived rates in Approved Cost and the rates quoted by the bidder or due to the difference in the quantity executed by the contractor. With respect to work item – *Dam* under the cost head *C – Civil Works*, the difference between either the rates quoted by bidder and the approved rates or the estimated and executed quantities of works has resulted in a cost difference of INR 73.92 lakhs. Similarly, the cost implication for work item – *Intake* under the same cost head *C – Civil Works* is INR 7.76 lakhs. For the work item *HRT*, and *Surge Shaft* under the cost head *J – Power House Civil Works*, the cost of under/over-provision in the Actual Cost has resulted in an amount of INR 220.55 lakhs, and INR 1.42 lakhs, respectively. Regarding the work item *Pressure Shaft*, the amount that has been over-provisioned is about INR 31.07 lakhs, which is inclusive of a contingencies and work charge establishment of INR 33.96 lakhs. Relating to *Power House*, the extent of over-provisioned amount is INR 91.89 lakhs. Items such as contingencies, insulation, flood protection wall with road on top, painting of exterior surfaces, deep pit excavation, shotcreting, structural steel works, and brickwork have been over-provisioned while work items such as excavation in rock, concreting using M20 and M25 grade concrete, rock bolting, and reinforcement have been under-provisioned. Regarding TRT, the work item that have been over-provisioned are concreting in tunnel lining, reinforcement works, and contingencies whereas work items such as tunnel excavation, rock bolting, and downstream cofferdam has been under-provisioned. The net cost implication of these is an amount of INR 350.33 lakhs. Finally, for the work item *Switchyard*, the items that have been over-provisioned are concreting in cable trenches and boundary pillars, and reinforcement steel while the work items such as open excavation in soil and rock had been under-provisioned.



With respect to Electro-Mechanical Works, the E&M package was carried out using EPC contract. The invoices for the works carried out by the firms executing/supplying the related equipment need to be segregated into appropriate cost heads. This will help to carry out similar kind of cost overrun analysis for E&M works also. The cost under the appropriate cost heads is not available due to difficulty in segregating the items and allocating to the appropriate cost heads. However, considering that the project is a low head scheme, the cost of INR 11,663.6 lakhs of E&M works for 40MW i.e. INR 2.92 crores per MW is quite reasonable.

Table 21 Cost Overrun Analysis of I - Direct Cost

| Item                        | Major Scope of Work                 | Approved Cost (2008) | Actual Cost (March' 19) | Cost Variation   | % Variation    | All cost figures in INR Lakhs<br>Actual Cost vs Approved Cost |                             |                  |                       |
|-----------------------------|-------------------------------------|----------------------|-------------------------|------------------|----------------|---|-----------------------------|------------------|-----------------------|
|                             |                                     |                      |                         |                  |                | Price Escalation  | Increase/ Decrease in Scope | Change in Design | Over/ Under Provision |
| 1                           | 2                                   | 3                    | 4                       | 4-3              | 4-3/3          |   |                             |                  |                       |
| Direct Cost                 |                                     |                      |                         |                  |                |   |                             |                  |                       |
| I - Works                   |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | A - Preliminary                     | 309.17               | 602.57                  | 293.40           | 94.90%         | -   | -                           | -                | 293.40                |
|                             | B - Land                            | 150.00               | 33.96                   | (116.04)         | -77.36%        | -   | -                           | -                | (116.04)              |
| C - Civil Works             |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | i. River care                       | -                    | -                       | -                |                |   |                             |                  |                       |
|                             | ii. Dam                             | 1,248.64             | 8,041.21                | 6,792.57         | 544.00%        | 693.47  | 2,869.51                    | 3,303.50         | (73.92)               |
|                             | iii. Intake                         | 926.37               | 1,593.98                | 667.61           | 72.07%         | 264.70  | 17.23                       | 1,162.64         | (776.97)              |
|                             | iv. Hydro mechanical                | 723.64               | 1,308.29                | 584.65           | 80.79%         | 404.11  | -                           | -                | 180.54                |
|                             | Sub Total – Civil Works             | 2,898.65             | 10,943.47               | 8,044.82         | 277.54%        | 1,362.29  | 2,886.74                    | 4,466.15         | (670.36)              |
| J - Power Plant Civil Works |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | i. Head race tunnel                 | 818.22               | 3,043.97                | 2,225.75         | 272.03%        | 436.88  | 788.08                      | 1,221.34         | (220.55)              |
|                             | ii. Surge shaft                     | 473.23               | 1,280.24                | 807.02           | 170.53%        | 210.82  | 180.25                      | 414.51           | 1.42                  |
|                             | iii. Pressure shaft / Penstock      | 722.46               | 1,271.40                | 548.94           | 75.98%         | 291.95  | 221.71                      | 66.34            | (31.07)               |
|                             | iv. Power house complex             | 2,484.82             | 4,319.10                | 1,834.29         | 73.82%         | 748.54  | 1,111.12                    | 66.37            | (91.89)               |
|                             | v. Tail race tunnel                 | 1,042.08             | 2,036.33                | 994.25           | 95.41%         | 250.24  | 687.95                      | 406.38           | (350.33)              |
|                             | vi. Switchyard                      | 179.99               | 409.97                  | 229.98           | 127.78%        | 95.80   | -                           | 80.78            | 53.40                 |
|                             | vii. Hydro mechanical works         | 185.58               | 567.83                  | 382.25           | 205.98%        | 144.80  | -                           | (35.85)          | 273.31                |
|                             | Sub Total - J - Works               | 5,906.37             | 12,928.85               | 7,022.48         | 118.90%        | 2,179.02  | 2,989.86                    | 2,219.90         | (365.72)              |
| K - Building                |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | M - Plantation                      | 13.80                | 8.63                    | (5.18)           | -37.50%        | -   | -                           | -                | (5.18)                |
| O - Miscellaneous           |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | P - Maintenance during Construction | 264.00               | 269.10                  | 5.10             | 1.93%          | -   | -                           | -                | 5.10                  |
| Q - Special T & P           |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | R - Communication                   | 100.32               | 63.95                   | (36.38)          | -36.26%        | -   | -                           | -                | (36.38)               |
|                             |                                     | 82.25                | 39.74                   | (42.51)          | -51.68%        | -   | -                           | -                | (42.51)               |
| R - Communication           |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | X - Environment & Ecology           | 416.84               | 863.05                  | 446.21           | 107.05%        | -   | -                           | -                | 446.21                |
| X - Environment & Ecology   |                                     |                      |                         |                  |                |   |                             |                  |                       |
|                             | Y - Losses on stock                 | 55.00                | 105.68                  | 50.68            | 92.14%         | -   | -                           | -                | 50.60                 |
|                             |                                     | 24.37                | -                       | (24.37)          | 100.00%        | -   | -                           | -                | (24.37)               |
| Y - Losses on stock         |                                     |                      |                         |                  |                |   |                             |                  |                       |
| <b>Total : I - Works</b>    |                                     | <b>10,698.22</b>     | <b>26,410.60</b>        | <b>15,712.38</b> | <b>146.87%</b> | <b>3,541.31</b>   | <b>5,876.61</b>             | <b>6,686.04</b>  | <b>(3,91.08)</b>      |

## Analysis of Time Overrun

The New Umtru H.E. Project was notionally assumed to start execution from October 2005 and complete it within 30 months. The pre-construction activities started in January, 2007 and main works started in January, 2008 after awarding the contract for Civil Works in December, 2007. The original schedule of the project has been developed using the information provided by the bidder for implementation of the civil works in the tender document. Figure 1 shows the original project schedule of the project, based on the inputs from bidder's package. The notable dates by which the key components of the project had been scheduled to complete is shown in Table 22. As per this schedule, the civil works should be completed by March, 2010 and the key components such as Dam, and Power House completing by February, 2010 and March, 2010, respectively. Other elements such as Intake Structure, and Surge Shaft completing by December, 2009.

A comparative analysis of the project schedule between the original schedule and actual dates of completion of the various project milestones has been undertaken. Figure 2 shows the project schedule showing the comparison between the original schedule and actual schedule of the project relating to civil works only. The comparison between the start date and completion date of the key elements of the project between the original schedule and actual schedule is summarised below:

Summary of the Original Schedule and Actual Schedule of the Project

| WBS    | Task Name              | Duration  | Actual Start | Actual Finish | Baseline Start | Baseline Finish |
|--------|------------------------|-----------|--------------|---------------|----------------|-----------------|
| 1      | New Umtru H.E. Project | 2468 days | 01-10-07     | 15-03-17      | 01-10-07       | 02-03-10        |
| 1.2    | Dam                    | 2450 days | 25-10-07     | 15-03-17      | 25-10-07       | 05-02-10        |
| 1.2.9  | Non-overflow section   | 923 days  | 01-09-13     | 15-03-17      | 05-03-08       | 06-03-08        |
| 1.2.10 | Hydro-mechanical works | 456 days  | 15-05-15     | 12-02-17      | 28-01-10       | 28-01-10        |
| 1.3    | Intake Structure       | 2000 days | 01-12-08     | 30-07-16      | 01-12-08       | 25-12-09        |
| 1.3.6  | Intake & sluice gate   | 1880 days | 20-03-09     | 02-06-16      | 17-03-09       | 20-03-09        |
| 1.4    | Head Race Tunnel       | 2146 days | 05-12-08     | 25-02-17      | 01-12-07       | 15-05-09        |
| 1.5    | Surge Shaft            | 1894 days | 31-10-09     | 02-02-17      | 01-11-08       | 08-12-09        |
| 1.5.5  | Hydro-mechanical works | 482 days  | 01-04-15     | 02-02-17      | 08-12-09       | 08-12-09        |
| 1.6    | Pressure Shaft         | 1600 days | 04-01-09     | 21-02-15      | 01-08-08       | 14-01-10        |
| 1.7    | Power House            | 2393 days | 14-01-08     | 15-03-17      | 01-12-07       | 02-03-10        |
| 1.7.15 | Hydro-mechanical works | 445 days  | 01-06-15     | 10-02-17      | 05-01-10       | 06-01-10        |
| 1.8    | Tail Race Tunnel       | 2189 days | 07-10-08     | 25-02-17      | 07-10-08       | 25-01-10        |
| 1.8.6  | TRT gate               | 1886 days | 04-12-09     | 25-02-17      | 01-12-09       | 04-12-09        |
| 1.9    | Switch Yard            | 750 days  | 01-03-14     | 15-01-17      | 01-11-08       | 09-07-09        |

A preliminary comparison of the original schedule with the actual schedule highlights that there is an extensive delay in completing the civil works of the project. A critical examination of this delay reveals that in the actual schedule several activities that were not envisaged in the initial schedule have been included. This highlights the fact that the scope of work had undergone changes and this ultimately affects not only the cost of the project but also prevent timely completion of the project within the original project schedule.

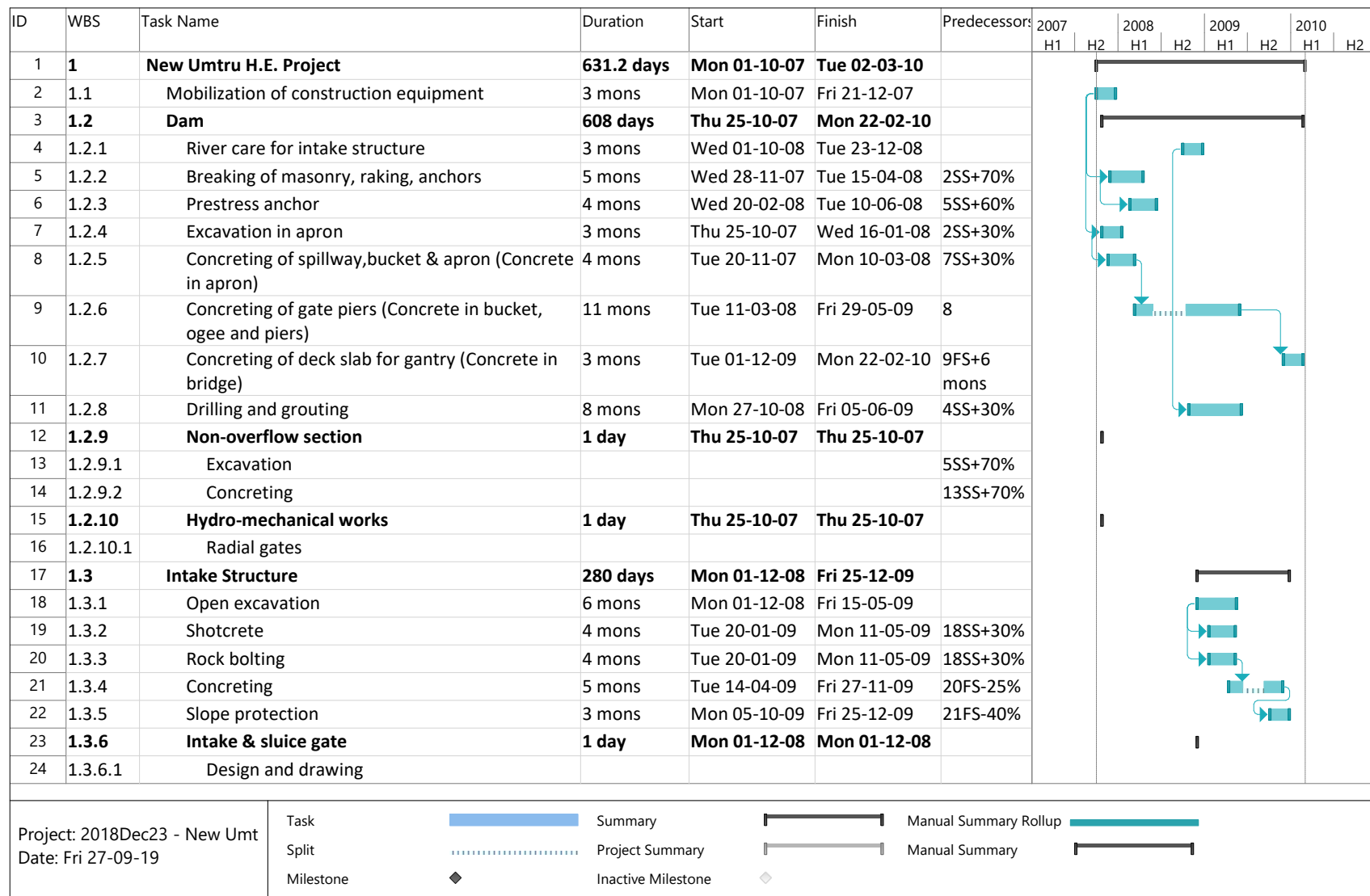


Figure 1 Original Project Schedule of New Umtru H.E. Project

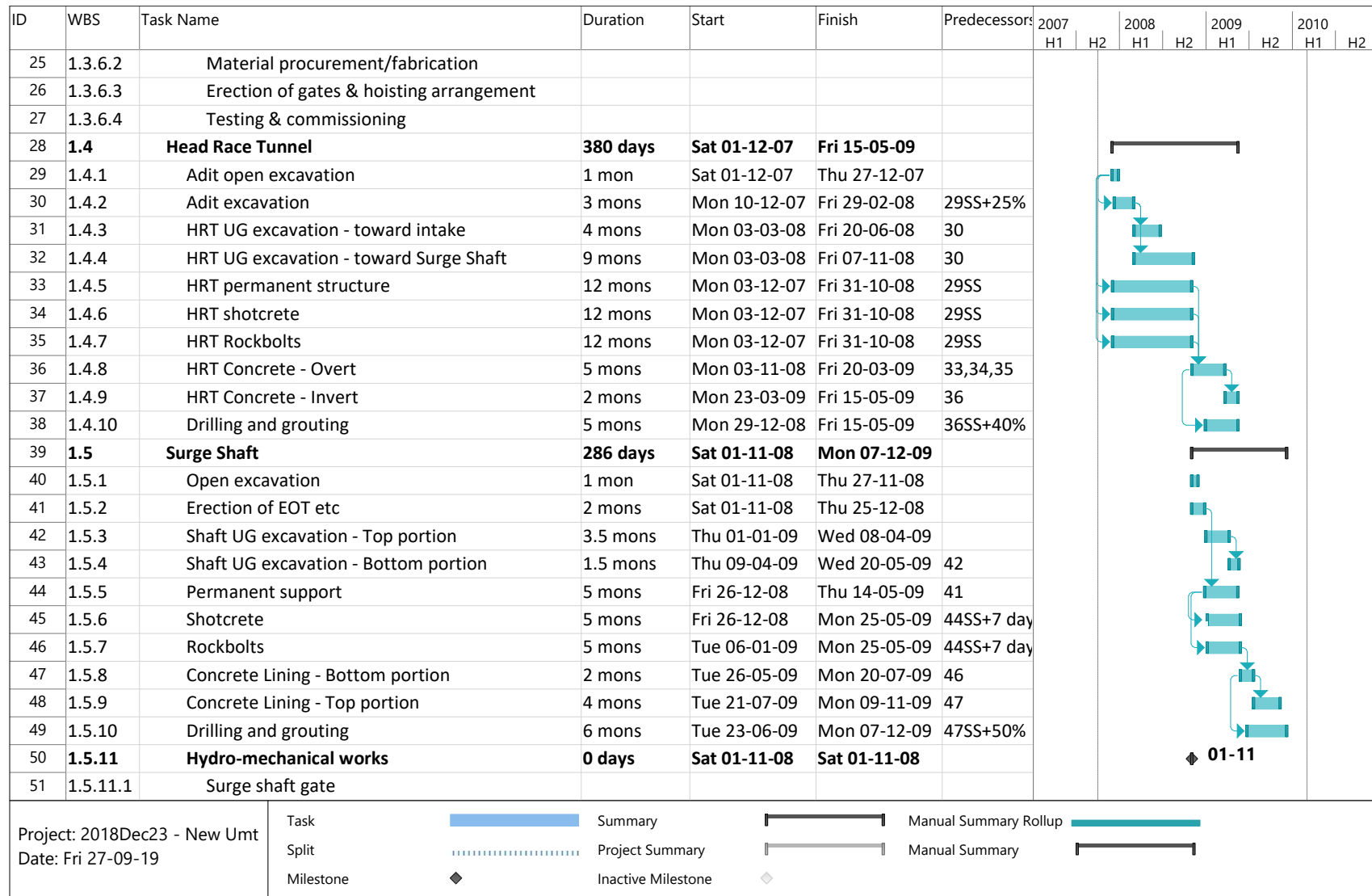


Figure 1 - Contd.

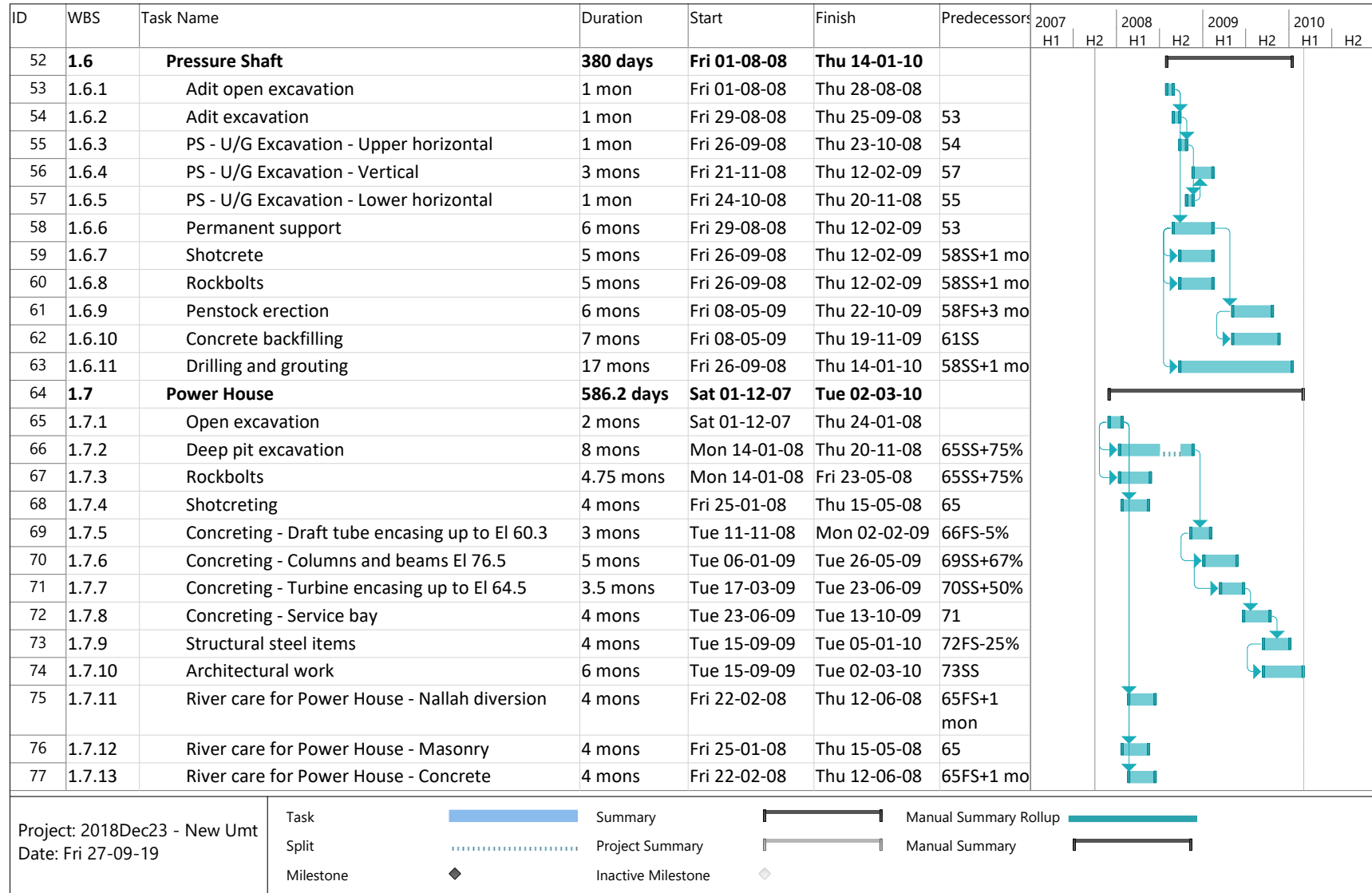


Figure 1 – Contd.



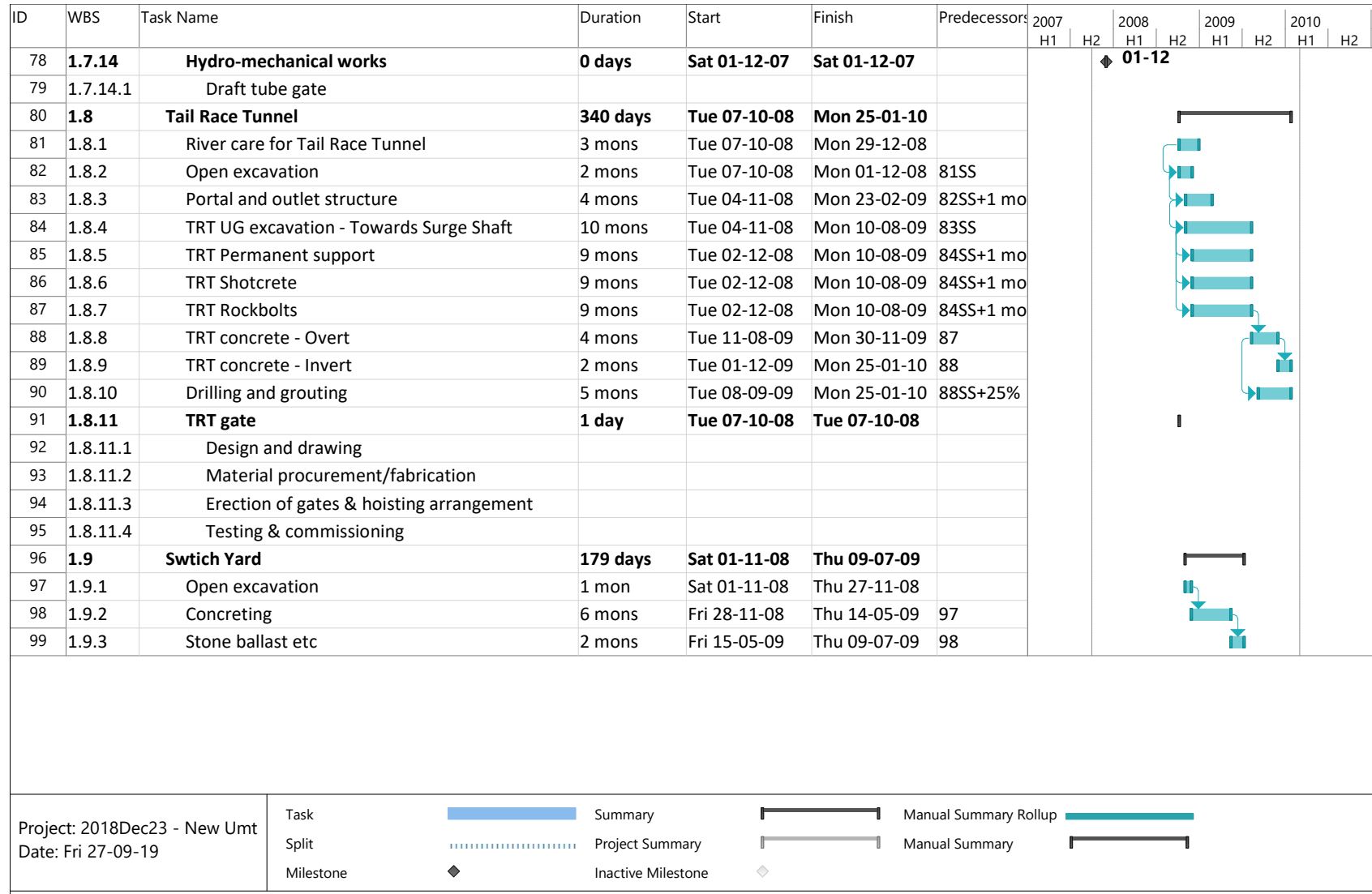


Figure 1– Contd.

Table 22 Milestones Dates for the Key Civil Works Elements of the Project as per Original Schedule

| WBS        | Task Name                                      | Duration          | Start           | Finish          | Predecessors |
|------------|--|-------------------|-----------------|-----------------|--------------|
| <b>1</b>   | <b>New Umtru H.E. Project</b>                  | <b>631.2 days</b> | <b>01-10-07</b> | <b>02-03-10</b> |              |
| 1.1        | Mobilization of construction equipment         | 3 mons            | 01-10-07        | 21-12-07        |              |
| <b>1.2</b> | <b>Dam</b>                                     | <b>608 days</b>   | <b>25-10-07</b> | <b>22-02-10</b> |              |
| 1.2.1      | River care for intake structure                | 3 mons            | 01-10-08        | 23-12-08        |              |
| 1.2.2      | Breaking of masonry, raking, anchors           | 5 mons            | 28-11-07        | 15-04-08        | 2SS+70%      |
| 1.2.3      | Pre-stress anchor                              | 4 mons            | 20-02-08        | 10-06-08        | 5SS+60%      |
| 1.2.4      | Excavation in apron                            | 3 mons            | 25-10-07        | 16-01-08        | 2SS+30%      |
| 1.2.5      | Concrete in apron                              | 4 mons            | 20-11-07        | 10-03-08        | 7SS+30%      |
| 1.2.6      | Concrete in bucket, ogee and piers             | 11 mons           | 11-03-08        | 29-05-09        | 8            |
| 1.2.7      | Concrete in bridge                             | 3 mons            | 01-12-09        | 22-02-10        |              |
| 1.2.8      | Drilling and grouting                          | 8 mons            | 27-10-08        | 05-06-09        | 4SS+30%      |
| <b>1.3</b> | <b>Intake Structure</b>                        | <b>280 days</b>   | <b>01-12-08</b> | <b>25-12-09</b> |              |
| 1.3.1      | Open excavation                                | 6 mons            | 01-12-08        | 15-05-09        |              |
| 1.3.2      | Shotcrete                                      | 4 mons            | 20-01-09        | 11-05-09        | 13SS+30%     |
| 1.3.3      | Rock bolting                                   | 4 mons            | 20-01-09        | 11-05-09        | 13SS+30%     |
| 1.3.4      | Concreting                                     | 5 mons            | 14-04-09        | 27-11-09        | 15FS-25%     |
| 1.3.5      | Slope protection                               | 3 mons            | 05-10-09        | 25-12-09        | 16FS-40%     |
| <b>1.4</b> | <b>Head Race Tunnel</b>                        | <b>380 days</b>   | <b>01-12-07</b> | <b>15-05-09</b> |              |
| 1.4.1      | Adit open excavation                           | 1 mon             | 01-12-07        | 27-12-07        |              |
| 1.4.2      | Adit excavation                                | 3 mons            | 10-12-07        | 29-02-08        | 19SS+25%     |
| 1.4.3      | HRT UG excavation - toward intake              | 4 mons            | 03-03-08        | 20-06-08        | 20           |
| 1.4.4      | HRT UG excavation - toward Surge Shaft         | 9 mons            | 03-03-08        | 07-11-08        | 20           |
| 1.4.5      | HRT permanent structure                        | 12 mons           | 03-12-07        | 31-10-08        | 19SS         |
| 1.4.6      | HRT shotcrete                                  | 12 mons           | 03-12-07        | 31-10-08        | 19SS         |
| 1.4.7      | HRT Rockbolts                                  | 12 mons           | 03-12-07        | 31-10-08        | 19SS         |
| 1.4.8      | HRT Concrete - Overt                           | 5 mons            | 03-11-08        | 20-03-09        | 23,24,25     |
| 1.4.9      | HRT Concrete - Invert                          | 2 mons            | 23-03-09        | 15-05-09        | 26           |
| 1.4.10     | Drilling and grouting                          | 5 mons            | 29-12-08        | 15-05-09        | 26SS+40%     |
| <b>1.5</b> | <b>Surge Shaft</b>                             | <b>286 days</b>   | <b>01-11-08</b> | <b>07-12-09</b> |              |
| 1.5.1      | Open excavation                                | 1 mon             | 01-11-08        | 27-11-08        |              |
| 1.5.2      | Erection of EOT etc                            | 2 mons            | 01-11-08        | 25-12-08        |              |
| 1.5.3      | Shaft UG excavation - Top portion              | 3.5 mons          | 01-01-09        | 08-04-09        |              |
| 1.5.4      | Shaft UG excavation - Bottom portion           | 1.5 mons          | 09-04-09        | 20-05-09        | 32           |
| 1.5.5      | Permanent support                              | 5 mons            | 26-12-08        | 14-05-09        | 31           |
| 1.5.6      | Shotcrete                                      | 5 mons            | 26-12-08        | 25-05-09        | 34SS+7 days  |
| 1.5.7      | Rockbolts                                      | 5 mons            | 06-01-09        | 25-05-09        | 34SS+7 days  |
| 1.5.8      | Concrete Lining - Bottom portion               | 2 mons            | 26-05-09        | 20-07-09        | 36           |
| 1.5.9      | Concrete Lining - Top portion                  | 4 mons            | 21-07-09        | 09-11-09        | 37           |
| 1.5.10     | Drilling and grouting                          | 6 mons            | 23-06-09        | 07-12-09        | 37SS+50%     |
| <b>1.6</b> | <b>Pressure Shaft</b>                          | <b>380 days</b>   | <b>01-08-08</b> | <b>14-01-10</b> |              |
| 1.6.1      | Adit open excavation                           | 1 mon             | 01-08-08        | 28-08-08        |              |
| 1.6.2      | Adit excavation                                | 1 mon             | 29-08-08        | 25-09-08        | 41           |
| 1.6.3      | PS - U/G Excavation - Upper horizontal         | 1 mon             | 26-09-08        | 23-10-08        | 42           |
| 1.6.4      | PS - U/G Excavation - Vertical                 | 3 mons            | 21-11-08        | 12-02-09        | 45           |
| 1.6.5      | PS - U/G Excavation - Lower horizontal         | 1 mon             | 24-10-08        | 20-11-08        | 43           |
| 1.6.6      | Permanent support                              | 6 mons            | 29-08-08        | 12-02-09        | 41           |
| 1.6.7      | Shotcrete                                      | 5 mons            | 26-09-08        | 12-02-09        | 46SS+1 mon   |
| 1.6.8      | Rockbolts                                      | 5 mons            | 26-09-08        | 12-02-09        | 46SS+1 mon   |
| 1.6.9      | Penstock erection                              | 6 mons            | 08-05-09        | 22-10-09        | 46FS+3 mon   |
| 1.6.10     | Concrete backfilling                           | 7 mons            | 08-05-09        | 19-11-09        | 49SS         |
| 1.6.11     | Drilling and grouting                          | 17 mons           | 26-09-08        | 14-01-10        | 46SS+1 mon   |
| <b>1.7</b> | <b>Power House</b>                             | <b>586.2 days</b> | <b>01-12-07</b> | <b>02-03-10</b> |              |
| 1.7.1      | Open excavation                                | 2 mons            | 01-12-07        | 24-01-08        |              |
| 1.7.2      | Deep pit excavation                            | 8 mons            | 14-01-08        | 20-11-08        | 53SS+75%     |
| 1.7.3      | Rockbolts                                      | 4.75 mons         | 14-01-08        | 23-05-08        | 53SS+75%     |
| 1.7.4      | Shotcreting                                    | 4 mons            | 25-01-08        | 15-05-08        | 53           |
| 1.7.5      | Concreting - Draft tube encasing up to El 60.3 | 3 mons            | 11-11-08        | 02-02-09        | 54FS-5%      |
| 1.7.6      | Concreting - Columns and beams El 76.5         | 5 mons            | 06-01-09        | 26-05-09        | 57SS+67%     |
| 1.7.7      | Concreting - Turbine encasing up to El 64.5    | 3.5 mons          | 17-03-09        | 23-06-09        | 58SS+50%     |

Contd.

Table 22 - Contd.

| WBS    | Task Name                                     | Duration        | Start           | Finish          | Predecessors |
|--------|---|-----------------|-----------------|-----------------|--------------|
| 1.7.8  | Concreting - Service bay                      | 4 mons          | 23-06-09        | 13-10-09        | 59           |
| 1.7.9  | Structural steel items                        | 4 mons          | 15-09-09        | 05-01-10        | 60FS-25%     |
| 1.7.10 | Architectural work                            | 6 mons          | 15-09-09        | 02-03-10        | 61SS         |
| 1.7.11 | River care for Power House - Nallah diversion | 4 mons          | 22-02-08        | 12-06-08        | 53FS+1 mon   |
| 1.7.12 | River care for Power House - Masonry          | 4 mons          | 25-01-08        | 15-05-08        | 53           |
| 1.7.13 | River care for Power House - Concrete         | 4 mons          | 22-02-08        | 12-06-08        | 53FS+1 mon   |
| 1.8    | <b>Tail Race Tunnel</b>                       | <b>340 days</b> | <b>07-10-08</b> | <b>25-01-10</b> |              |
| 1.8.1  | River care for Tail Race Tunnel               | 3 mons          | 07-10-08        | 29-12-08        |              |
| 1.8.2  | Open excavation                               | 2 mons          | 07-10-08        | 01-12-08        | 67SS         |
| 1.8.3  | Portal and outlet structure                   | 4 mons          | 04-11-08        | 23-02-09        | 68SS+1 mon   |
| 1.8.4  | TRT UG excavation - Towards Surge Shaft       | 10 mons         | 04-11-08        | 10-08-09        | 69SS         |
| 1.8.5  | TRT Permanent support                         | 9 mons          | 02-12-08        | 10-08-09        | 70SS+1 mon   |
| 1.8.6  | TRT Shotcrete                                 | 9 mons          | 02-12-08        | 10-08-09        | 70SS+1 mon   |
| 1.8.7  | TRT Rockbolts                                 | 9 mons          | 02-12-08        | 10-08-09        | 70SS+1 mon   |
| 1.8.8  | TRT concrete - Overt                          | 4 mons          | 11-08-09        | 30-11-09        | 73           |
| 1.8.9  | TRT concrete - Invert                         | 2 mons          | 01-12-09        | 25-01-10        | 74           |
| 1.8.10 | Drilling and grouting                         | 5 mons          | 08-09-09        | 25-01-10        | 74SS+25%     |
| 1.9    | <b>Switch Yard</b>                            | <b>179 days</b> | <b>01-11-08</b> | <b>09-07-09</b> |              |
| 1.9.1  | Open excavation                               | 1 mon           | 01-11-08        | 27-11-08        |              |
| 1.9.2  | Concreting                                    | 6 mons          | 28-11-08        | 14-05-09        | 78           |
| 1.9.3  | Stone ballast etc.                            | 2 mons          | 15-05-09        | 09-07-09        | 79           |

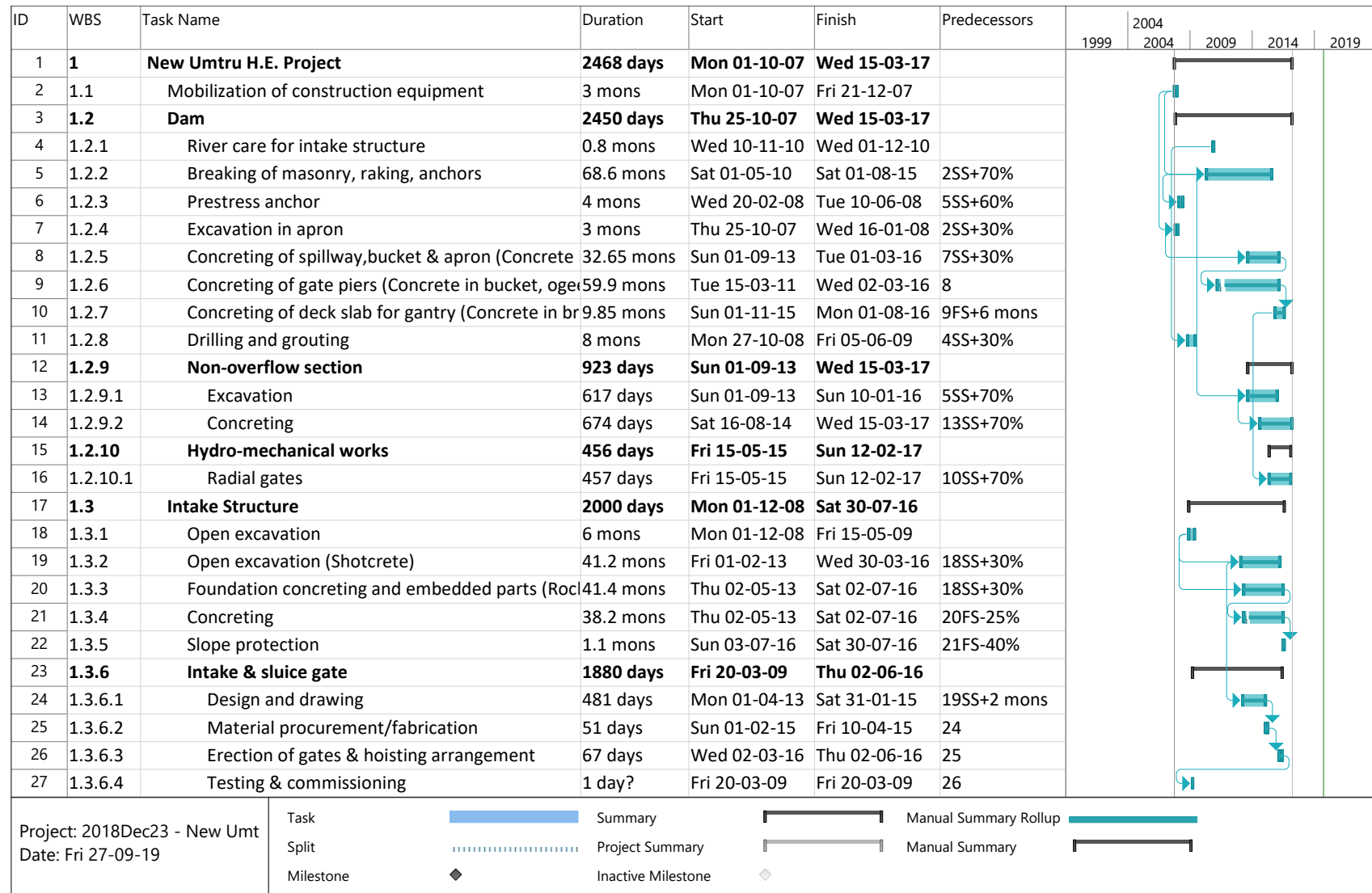


Figure 2 Schedule of the Project as per Actual Completion Dates

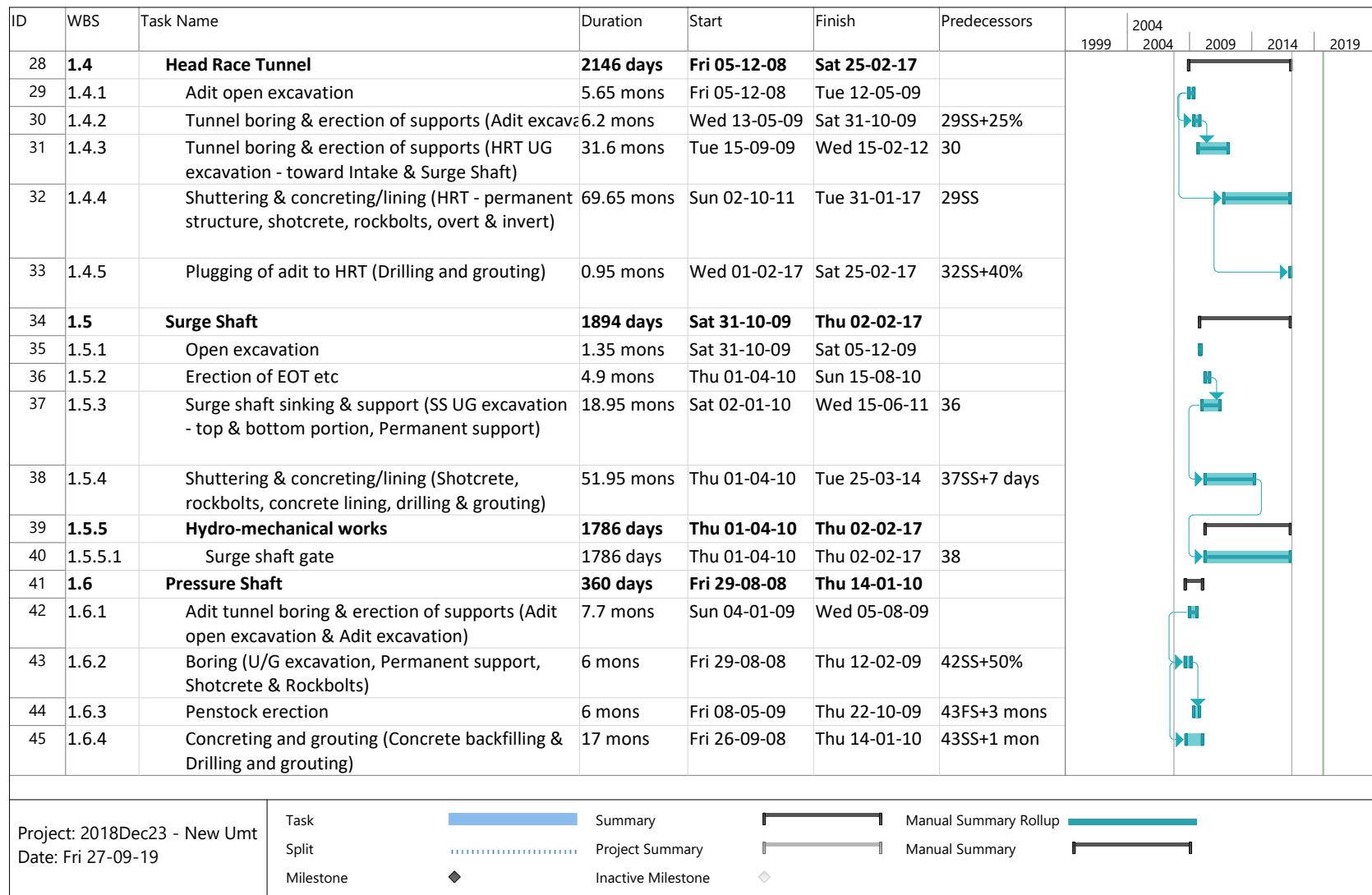


Figure 2 – Contd.

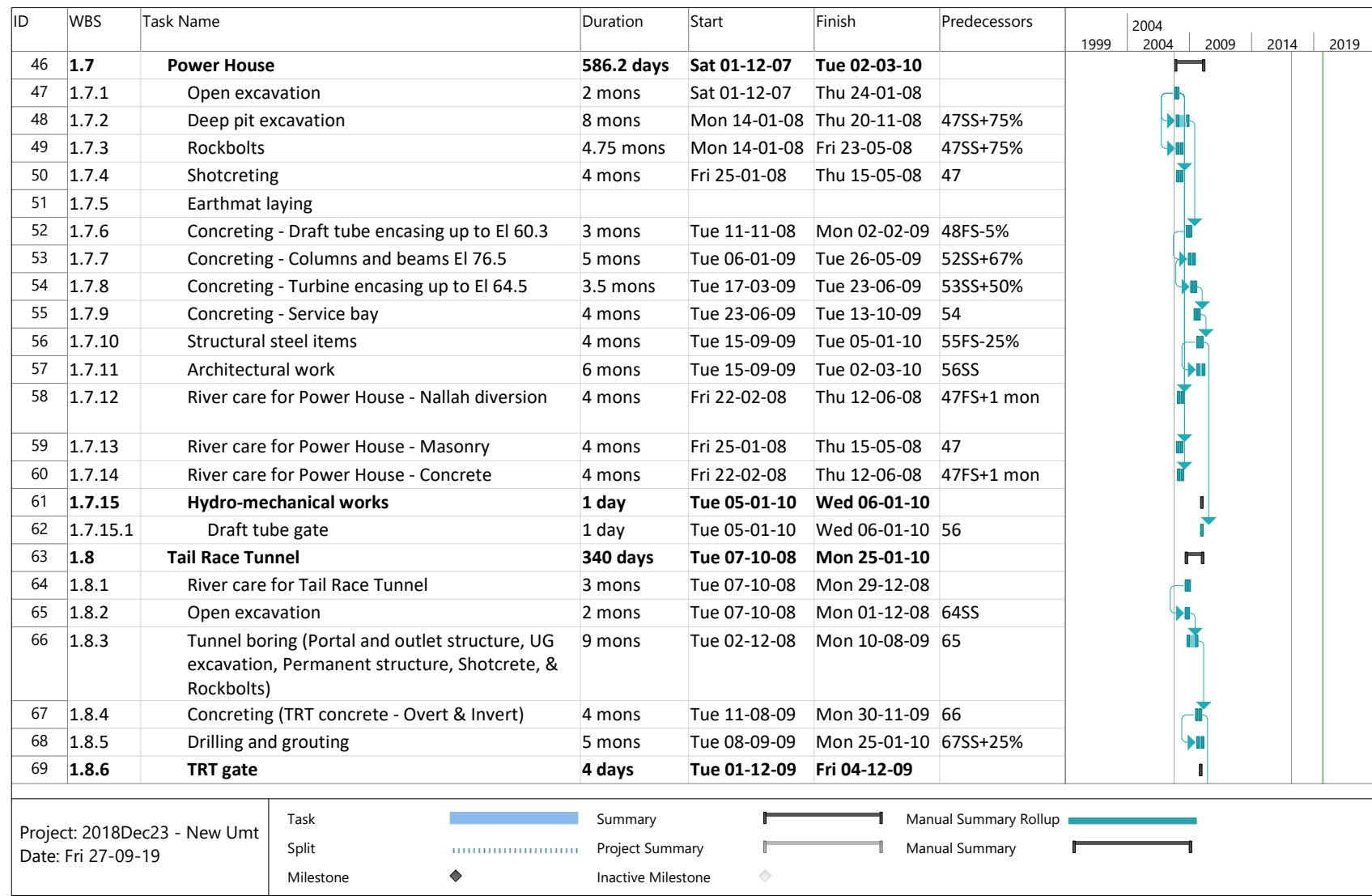


Figure 2 – Contd.

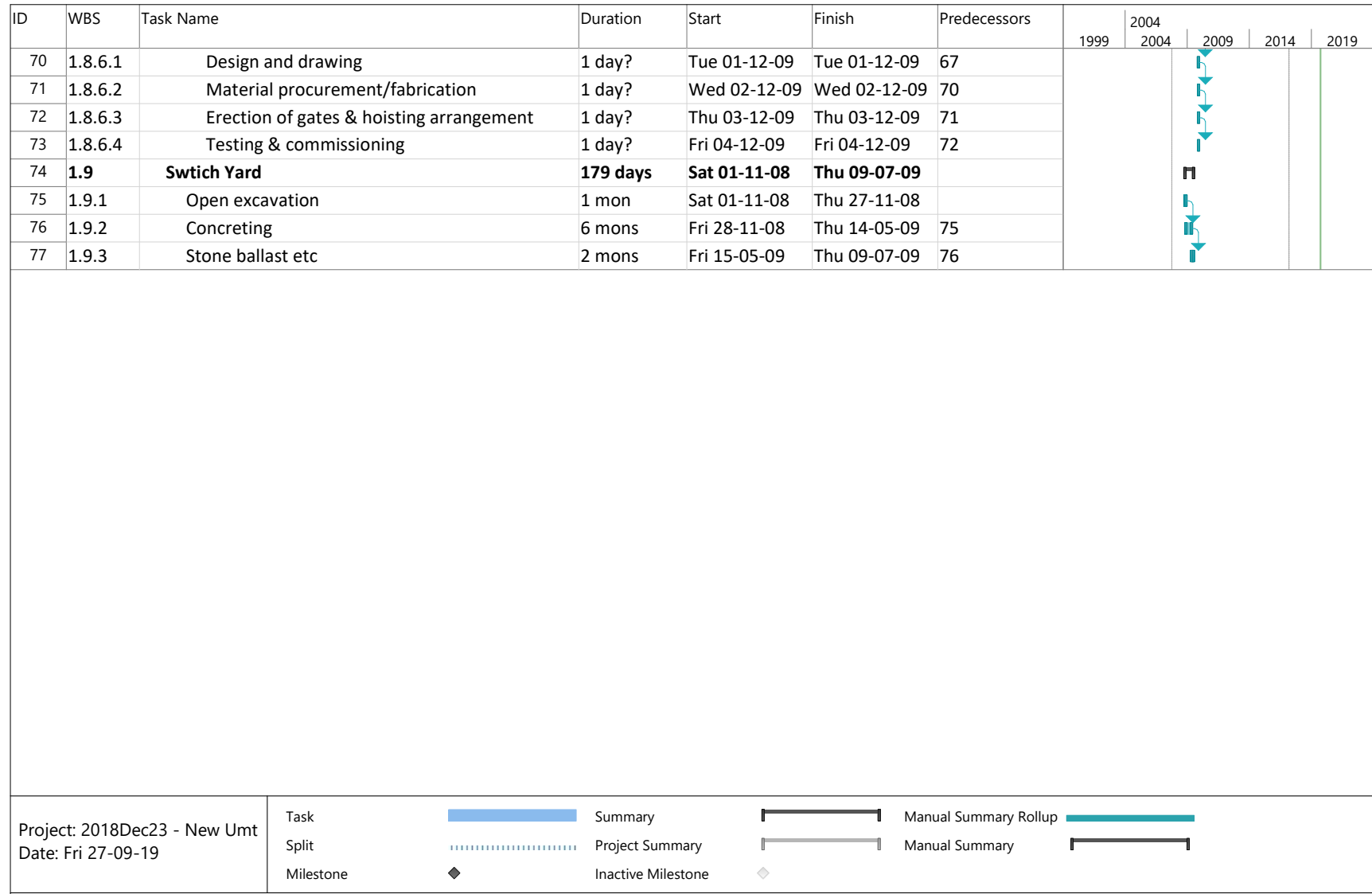


Figure 2 – Contd.



Table 23 Actual Schedule vs Original Schedule of the Project

| WBS             | Task Name   | Duration         | Actual Start    | Actual Finish   | Predecessors | Baseline Start  | Baseline Finish | % Complete  |
|-----------------|---|------------------|-----------------|-----------------|--------------|-----------------|-----------------|-------------|
| <b>1</b>        | <b>New Umtru H.E. Project</b>   | <b>2468 days</b> | <b>01-10-07</b> | <b>15-03-17</b> |              | <b>01-10-07</b> | <b>02-03-10</b> | <b>97%</b>  |
| <b>1.1</b>      | Mobilization of construction equipment  | 3 mons           | 01-10-07        | 21-12-07        |              | 01-10-07        | 21-12-07        | 0%          |
| <b>1.2</b>      | <b>Dam</b>  | <b>2450 days</b> | <b>25-10-07</b> | <b>15-03-17</b> |              | <b>25-10-07</b> | <b>05-02-10</b> | <b>95%</b>  |
| <b>1.2.1</b>    | Diversion arrangement (River care for intake structure)                         | 0.8 mons         | 10-11-10        | 01-12-10        |              | 01-10-08        | 23-12-08        | 100%        |
| <b>1.2.2</b>    | Excavation / Removal of old masonry (Breaking of masonry, raking, anchors)      | 68.6 mons        | 01-05-10        | 01-08-15        | 2SS+70%      | 28-11-07        | 15-04-08        | 100%        |
| <b>1.2.3</b>    | Pre-stress anchor   | 4 mons           | 20-02-08        | 10-06-08        | 5SS+60%      | 20-02-08        | 10-06-08        | 0%          |
| <b>1.2.4</b>    | Excavation in apron   | 3 mons           | 25-10-07        | 16-01-08        | 2SS+30%      | 25-10-07        | 16-01-08        | 0%          |
| <b>1.2.5</b>    | Concreting of spillway, bucket & apron (Concrete in apron)                      | 32.65 mons       | 01-09-13        | 01-03-16        | 7SS+30%      | 20-11-07        | 10-03-08        | 100%        |
| <b>1.2.6</b>    | Concreting of gate piers (Concrete in bucket, ogee and piers)                   | 59.9 mons        | 15-03-11        | 02-03-16        | 8            | 11-03-08        | 29-05-09        | 100%        |
| <b>1.2.7</b>    | Concreting of deck slab for gantry (Concrete in bridge)                         | 9.85 mons        | 01-11-15        | 01-08-16        | 9FS+6 mons   | 16-11-09        | 05-02-10        | 100%        |
| <b>1.2.8</b>    | Drilling and grouting   | 8 mons           | 27-10-08        | 05-06-09        | 4SS+30%      | 27-10-08        | 05-06-09        | 0%          |
| <b>1.2.9</b>    | <b>Non-overflow section</b>   | <b>923 days</b>  | <b>01-09-13</b> | <b>15-03-17</b> |              | <b>05-03-08</b> | <b>06-03-08</b> | <b>100%</b> |
| <b>1.2.9.1</b>  | Excavation  | 617 days         | 01-09-13        | 10-01-16        | 5SS+70%      | 05-03-08        | 05-03-08        | 100%        |
| <b>1.2.9.2</b>  | Concreting  | 674 days         | 16-08-14        | 15-03-17        | 13SS+70%     | 05-03-08        | 06-03-08        | 100%        |
| <b>1.2.10</b>   | <b>Hydro-mechanical works</b>   | <b>456 days</b>  | <b>15-05-15</b> | <b>12-02-17</b> |              | <b>28-01-10</b> | <b>28-01-10</b> | <b>100%</b> |
| <b>1.2.10.1</b> | Radial gates  | 457 days         | 15-05-15        | 12-02-17        | 10SS+70%     | 28-01-10        | 28-01-10        | 100%        |
| <b>1.3</b>      | <b>Intake Structure</b>   | <b>2000 days</b> | <b>01-12-08</b> | <b>30-07-16</b> |              | <b>01-12-08</b> | <b>25-12-09</b> | <b>96%</b>  |
| <b>1.3.1</b>    | Diversion arrangement (Open excavation)   | 6 mons           | 01-12-08        | 15-05-09        |              | 01-12-08        | 15-05-09        | 0%          |
| <b>1.3.2</b>    | Open excavation (Shotcrete)   | 41.2 mons        | 01-02-13        | 30-03-16        | 18SS+30%     | 20-01-09        | 11-05-09        | 100%        |
| <b>1.3.3</b>    | Foundation concreting and embedded parts (Rock bolting)                         | 41.4 mons        | 02-05-13        | 02-07-16        | 18SS+30%     | 20-01-09        | 11-05-09        | 100%        |
| <b>1.3.4</b>    | Concreting  | 38.2 mons        | 02-05-13        | 02-07-16        | 20FS-25%     | 14-04-09        | 27-11-09        | 100%        |
| <b>1.3.5</b>    | Finishing (Slope protection)  | 1.1 mons         | 03-07-16        | 30-07-16        | 21FS-40%     | 05-10-09        | 25-12-09        | 100%        |
| <b>1.3.6</b>    | <b>Intake &amp; sluice gate</b>   | <b>1880 days</b> | <b>20-03-09</b> | <b>02-06-16</b> |              | <b>17-03-09</b> | <b>20-03-09</b> | <b>99%</b>  |
| <b>1.3.6.1</b>  | Design and drawing  | 481 days         | 01-04-13        | 31-01-15        | 19SS+2 mons  | 17-03-09        | 17-03-09        | 100%        |
| <b>1.3.6.2</b>  | Material procurement/fabrication  | 51 days          | 01-02-15        | 10-04-15        | 24           | 18-03-09        | 18-03-09        | 100%        |
| <b>1.3.6.3</b>  | Erection of gates & hoisting arrangement  | 67 days          | 02-03-16        | 02-06-16        | 25           | 19-03-09        | 19-03-09        | 100%        |
| <b>1.3.6.4</b>  | Testing & commissioning   | 1 day?           | 20-03-09        | 20-03-09        | 26           | 20-03-09        | 20-03-09        | 0%          |
| <b>1.4</b>      | <b>Head Race Tunnel</b>   | <b>2146 days</b> | <b>05-12-08</b> | <b>25-02-17</b> |              | <b>01-12-07</b> | <b>15-05-09</b> | <b>100%</b> |
| <b>1.4.1</b>    | Adit open excavation  | 5.65 mons        | 05-12-08        | 12-05-09        |              | 01-12-07        | 27-12-07        | 100%        |
| <b>1.4.2</b>    | Tunnel boring & erection of supports (Adit excavation)                          | 6.2 mons         | 13-05-09        | 31-10-09        | 29SS+25%     | 10-12-07        | 29-02-08        | 100%        |
| <b>1.4.3</b>    | Tunnel boring & erection of supports (HRT UG excavation - toward Intake & SS)   | 6.2 mons         | 13-05-09        | 31-10-09        | 30           | 03-03-08        | 07-11-08        | 100%        |
| <b>1.4.4</b>    | Shuttering & concreting/lining (HRT - PS, shotcrete, rockbolts, overt & invert) | 69.65 mons       | 02-10-11        | 31-01-17        | 29SS         | 03-12-07        | 15-05-09        | 100%        |
| <b>1.4.5</b>    | Plugging of adit to HRT (Drilling and grouting)                                 | 0.95 mons        | 01-02-17        | 25-02-17        | 32SS+40%     | 29-12-08        | 15-05-09        | 100%        |
| <b>1.5</b>      | <b>Surge Shaft</b>  | <b>1894 days</b> | <b>31-10-09</b> | <b>02-02-17</b> |              | <b>01-11-08</b> | <b>08-12-09</b> | <b>100%</b> |
| <b>1.5.1</b>    | Open excavation   | 1.35 mons        | 31-10-09        | 05-12-09        |              | 01-11-08        | 27-11-08        | 100%        |
| <b>1.5.2</b>    | Erection of EOT etc.  | 4.9 mons         | 01-04-10        | 15-08-10        |              | 01-11-08        | 25-12-08        | 100%        |

Contd.

Table 23 - Contd.

| WBS      | Task Name   | Duration         | Actual Start    | Actual Finish   | Predecessors | Baseline Start  | Baseline Finish | % Complete  |
|----------|---|------------------|-----------------|-----------------|--------------|-----------------|-----------------|-------------|
| 1.5.3    | Surge shaft sinking & support (SS UG excavation – top & bottom portion, PS)                 | 18.95 mons       | 02-01-10        | 15-06-11        | 36           | 26-12-08        | 20-05-09        | 100%        |
| 1.5.4    | Shuttering & concreting/lining (Shotcrete, rockbolts, concrete lining, drilling & grouting) | 51.95 mons       | 01-04-10        | 25-03-14        | 37SS+7 days  | 26-12-08        | 07-12-09        | 100%        |
| 1.5.5    | <b>Hydro-mechanical works</b>   | <b>482 days</b>  | <b>01-04-15</b> | <b>02-02-17</b> |              | <b>08-12-09</b> | <b>08-12-09</b> | <b>100%</b> |
| 1.5.5.1  | Surge shaft gate  | 482 days         | 01-04-15        | 02-02-17        | 38           | 08-12-09        | 08-12-09        | 100%        |
| 1.6      | <b>Pressure Shaft</b>   | <b>1600 days</b> | <b>04-01-09</b> | <b>21-02-15</b> |              | <b>01-08-08</b> | <b>14-01-10</b> | <b>100%</b> |
| 1.6.1    | Adit tunnel boring & erection of supports (Adit open excavation & Adit excavation)          | 7.7 mons         | 04-01-09        | 05-08-09        |              | 01-08-08        | 25-09-08        | 100%        |
| 1.6.2    | Boring (PS – U/G Excavation – Upper horizontal)   | 3.8 mons         | 01-09-09        | 15-12-09        | 42SS+50%     | 29-08-08        | 25-09-08        | 100%        |
| 1.6.3    | Boring (PS – U/G Excavation – Vertical)   | 13 mons          | 31-07-10        | 28-07-11        | 43           | 26-09-08        | 18-12-08        | 100%        |
| 1.6.4    | Boring (PS – U/G Excavation – Lower horizontal)   | 5.55 mons        | 01-03-10        | 31-07-10        | 44           | 19-12-08        | 15-01-09        | 100%        |
| 1.6.5    | Boring (Permanent structure, Shotcrete, & Rockbolts)  | 17.95 mons       | 15-03-10        | 28-07-11        | 42           | 26-09-08        | 12-03-09        | 100%        |
| 1.6.6    | Penstock erection   | 24.25 mons       | 01-09-12        | 10-07-14        | 43FS+3 mons  | 08-05-09        | 22-10-09        | 100%        |
| 1.6.7    | Concreting and grouting (Concrete backfilling & Drilling and grouting)                      | 8.1 mons         | 11-07-14        | 21-02-15        | 43SS+1 mon   | 26-09-08        | 14-01-10        | 100%        |
| 1.7      | <b>Power House</b>  | <b>2393 days</b> | <b>14-01-08</b> | <b>15-03-17</b> |              | <b>01-12-07</b> | <b>02-03-10</b> | <b>97%</b>  |
| 1.7.1    | Open excavation   | 2.05 mons        | 04-01-09        | 27-02-09        |              | 01-12-07        | 24-01-08        | 100%        |
| 1.7.2    | Deep pit excavation   | 26.85 mons       | 02-03-09        | 19-06-11        | 50SS+75%     | 14-01-08        | 20-11-08        | 100%        |
| 1.7.3    | Rockbolts   | 4.75 mons        | 14-01-08        | 23-05-08        | 50SS+75%     | 14-01-08        | 23-05-08        | 0%          |
| 1.7.4    | Shotcreting   | 4 mons           | 25-01-08        | 15-05-08        | 50           | 25-01-08        | 15-05-08        | 0%          |
| 1.7.5    | Earthmat laying   | 1044 days        | 30-06-11        | 30-06-15        | 51           | 21-11-08        | 21-11-08        | 100%        |
| 1.7.6    | Concreting – Draft tube encasing up to El 60.3  | 17.15 mons       | 10-08-11        | 30-11-12        | 51FS-5%      | 11-11-08        | 02-02-09        | 100%        |
| 1.7.7    | Concreting – Columns and beams El 76.5  | 49.45 mons       | 20-06-11        | 02-04-15        | 55SS+67%     | 06-01-09        | 26-05-09        | 100%        |
| 1.7.8    | Concreting – Turbine encasing up to El 64.5   | 3.2 mons         | 05-12-11        | 01-03-12        | 56SS+50%     | 17-03-09        | 23-06-09        | 100%        |
| 1.7.9    | Concreting – Service bay  | 38.55 mons       | 20-06-11        | 01-06-14        | 57           | 23-06-09        | 13-10-09        | 100%        |
| 1.7.10   | Structural steel items  | 1.75 mons        | 02-04-15        | 20-05-15        | 58FS-25%     | 15-09-09        | 05-01-10        | 100%        |
| 1.7.11   | Finishing/brickwork/flooring etc (Architectural work)                                       | 11.45 mons       | 01-05-16        | 15-03-17        | 59SS         | 15-09-09        | 02-03-10        | 100%        |
| 1.7.12   | Nallah diversion (River care for Power House – Nallah diversion)                            | 26.3 mons        | 06-12-08        | 10-12-10        | 50FS+1 mon   | 22-02-08        | 12-06-08        | 100%        |
| 1.7.13   | Flood protection wall – Masonry (River care for Power House – Masonry)                      | 1.1 mons         | 06-12-08        | 05-01-09        | 50           | 25-01-08        | 15-05-08        | 100%        |
| 1.7.14   | Flood protection wall – Concrete (River care for Power House – Concrete)                    | 31.85 mons       | 06-01-09        | 15-06-11        | 50FS+1 mon   | 22-02-08        | 12-06-08        | 100%        |
| 1.7.15   | <b>Hydro-mechanical works</b>   | <b>445 days</b>  | <b>01-06-15</b> | <b>10-02-17</b> |              | <b>05-01-10</b> | <b>06-01-10</b> | <b>100%</b> |
| 1.7.15.1 | Draft tube gate   | 445 days         | 01-06-15        | 10-02-17        | 59           | 05-01-10        | 06-01-10        | 100%        |
| 1.8      | <b>Tail Race Tunnel</b>   | <b>2189 days</b> | <b>07-10-08</b> | <b>25-02-17</b> |              | <b>07-10-08</b> | <b>25-01-10</b> | <b>98%</b>  |
| 1.8.1    | River care for Tail Race Tunnel   | 3 mons           | 07-10-08        | 29-12-08        |              | 07-10-08        | 29-12-08        | 0%          |
| 1.8.2    | Open excavation   | 2.2 mons         | 01-04-09        | 31-05-09        | 67SS         | 07-10-08        | 01-12-08        | 100%        |
| 1.8.3    | Tunnel boring (Portal and outlet structure, UG excavation, PS, Shotcrete, & Rockbolts)      | 33.8 mons        | 01-09-09        | 03-04-12        | 68           | 02-12-08        | 10-08-09        | 100%        |
| 1.8.4    | Concreting (TRT concrete – Overt & Invert)  | 44.15 mons       | 15-12-11        | 02-05-15        | 69           | 11-08-09        | 30-11-09        | 100%        |
| 1.8.5    | Drilling and grouting   | 44.15 mons       | 15-12-11        | 02-05-15        | 70SS+25%     | 08-09-09        | 25-01-10        | 100%        |

Contd.

Table 23 - Contd.

| WBS            | Task Name                                | Duration         | Actual Start    | Actual Finish   | Predecessors | Baseline Start  | Baseline Finish | % Complete  |
|----------------|--|------------------|-----------------|-----------------|--------------|-----------------|-----------------|-------------|
| <b>1.8.6</b>   | <b>TRT gate</b>                          | <b>1886 days</b> | <b>04-12-09</b> | <b>25-02-17</b> |              | <b>01-12-09</b> | <b>04-12-09</b> | <b>99%</b>  |
| <b>1.8.6.1</b> | Design and drawing                       | 67 days          | 01-05-16        | 01-08-16        | 70           | 01-12-09        | 01-12-09        | 100%        |
| <b>1.8.6.2</b> | Material procurement/fabrication         | 37 days          | 01-10-16        | 20-11-16        | 73           | 02-12-09        | 02-12-09        | 100%        |
| <b>1.8.6.3</b> | Erection of gates & hoisting arrangement | 42 days          | 01-01-17        | 25-02-17        | 74           | 03-12-09        | 03-12-09        | 100%        |
| <b>1.8.6.4</b> | Testing & commissioning                  | 1 day?           | 04-12-09        | 04-12-09        | 75           | 04-12-09        | 04-12-09        | 0%          |
| <b>1.9</b>     | <b>Switch Yard</b>                       | <b>750 days</b>  | <b>01-03-14</b> | <b>15-01-17</b> |              | <b>01-11-08</b> | <b>09-07-09</b> | <b>100%</b> |
| <b>1.9.1</b>   | Open excavation                          | 11.35 mons       | 01-03-14        | 10-01-15        |              | 01-11-08        | 27-11-08        | 100%        |
| <b>1.9.2</b>   | Concreting                               | 32.3 mons        | 01-07-14        | 20-12-16        | 78           | 28-11-08        | 14-05-09        | 100%        |
| <b>1.9.3</b>   | Stone ballast etc                        | 11.45 mons       | 02-03-16        | 15-01-17        | 79           | 15-05-09        | 09-07-09        | 100%        |

In order to ascertain the reasons for the delay in completing the project as per the original schedule, the various events that might have prevented timely completion of the project were solicited from the implementing agency and the following were some of the notable reasons:

- Work had to be stopped due to problems in acquisition of land for the project, in the initial stage of the construction. Land was not available in 2008 for powerhouse and the actual excavation started only on January 2009.
- Change in the construction methodology of the project had increased the scope of the work. The original scope of the work envisaged use of the original old masonry weir for the project but, as per the CWC recommendation, it was instructed to construct a new dam instead of using the old masonry weir. This has resulted in stoppage of works in 2008. Subsequent to this design change, the actual breaking of the old masonry weir was started after almost two years from the original commencement date of the project (i.e. October 2010).
- Furthermore, due to change in the Land Acquisition Act, work had to be delayed on account of delay in payment of compensation to the land owners upstream of the project. Local NGOs and land owners had stopped the works on several occasions, as a result the right bank of the NOF section cannot be taken up from July 30<sup>th</sup>, 2014. This issue was, finally, resolved in February 24<sup>th</sup>, 2015.
- Unavailability of requisite test data for design purpose due to stoppage of core drilling works by the land owners had prevented timely completion of the design of Non-Overflow Blocks of the Dam. The land owners have stopped the work during the period between July 30<sup>th</sup>, 2014 and February 24<sup>th</sup>, 2015.
- Civil works and Electro-Mechanical works had to be stopped due to suspension of works by the civil contractor and electro-mechanical contractor during the period December 1<sup>st</sup>, 2013 to February 11<sup>th</sup>, 2014, and November 29<sup>th</sup>, 2013 to March, 2014, respectively. The reason for the stoppage of the works by contractors was on account of non-payment of their RA bills, which had accumulated over a period time resulting in huge outstanding bills.
- Change in scope of works: The scope of the work had to be changed after sanctioning of the project due to several reasons. The reasons are: (i) Change in design flood; (ii) Increase in length of non-overflow block; (iii) Shifting of the intake structure; and (iv) Change in project layout. These had resulted in the need for additional design and subsequent approval by concern authority, thereby resulting in the failure to execute the work as planned initially.
- Presence of shear zone and poor geological conditions had also resulted in the need for additional works beyond the initially envisaged scope of work.
- Besides the above-mentioned events, the project also had poor cash-flow and the failure to close the financing of the project on a timely basis had resulted in scarcity of funds. This had affected the progress of the project.

If the influence of only the change in construction methodology on the dam and the delay in land acquisition is taken into account and observe the change that it might have on the original schedule, without considering the implication of the increase in scope of the work, then the revised project schedule indicates that project should complete by March 2013.

Figure 3 shows how the original project schedule of the project gets delay on introduction of the effect of change in construction methodology and problem of land acquisition. The

notable dates by which the key components of the project had been scheduled to complete as per the revised schedule is shown in Table 24. The implication of these events is that the completion date of the project has been changed to March 2013 from the original schedule of March 2010.

The project had experienced severe financial constraints during the course of the project execution. The debt component of the project fund was initially funded with loan from HUDCO. Due to change in scope of the work, the project cost had to be revised, resulting in the need for additional funding. The project cost was, thus, revised in April, 2012 and the same revised cost was approved in December, 2012. But the financial institution expressed its inability to provide the additional funding requirement. The implementing agency then had to approach another financial institution, PFC, for funding the revised project cost. However, arranging the funding from PFC required several legal formalities to be completed before releasing of the loan to the implementing agency. PFC sanctioned the debt financing in May, 2014. During this period from revision of project to sanction by PFC, the contractor had even stopped the work. These events highlight the fact that, besides the change in scope of work, inability to ensure timely funding to the project might have created severe fund crunch and payments to the contractors for completion of project in a timely manner. The implication of this event is introduced in the revised schedule by considering that work progress has slowed down due to financial crunch experienced during the period April 2012 to March 2014. The effects of these on the various items of work is shown in Figure 4 and Table 25. It could be observed from this revised schedule that project should complete by March, 2015.

Besides these two events, if the other design changes are also taken into consideration then the scope of the work had to be increased tremendously. Incorporation of these changes will also require substantial reworking and redesigning, resulting in delay. The implications of these events could, however, not be taken into the delay analysis exercise as it is not possible to precisely allocate the events to the activities. But, it will not be incorrect to say that even if works were taken up during the original time schedule, the massive increase in quantities due to change in scope would make it impossible to maintain the original time schedule. Thus, considering all these events and the time by which the project has completed (i.e. 2017), it will not be incorrect to state that project completion time appears to be quite reasonable from the delay analysis.

With respect to the electro-mechanical works, the lack of an original schedule and actual schedule for this work prevented analysis of time overrun of the project on account of the various events that might have been encountered during the execution of the electro-mechanical works.

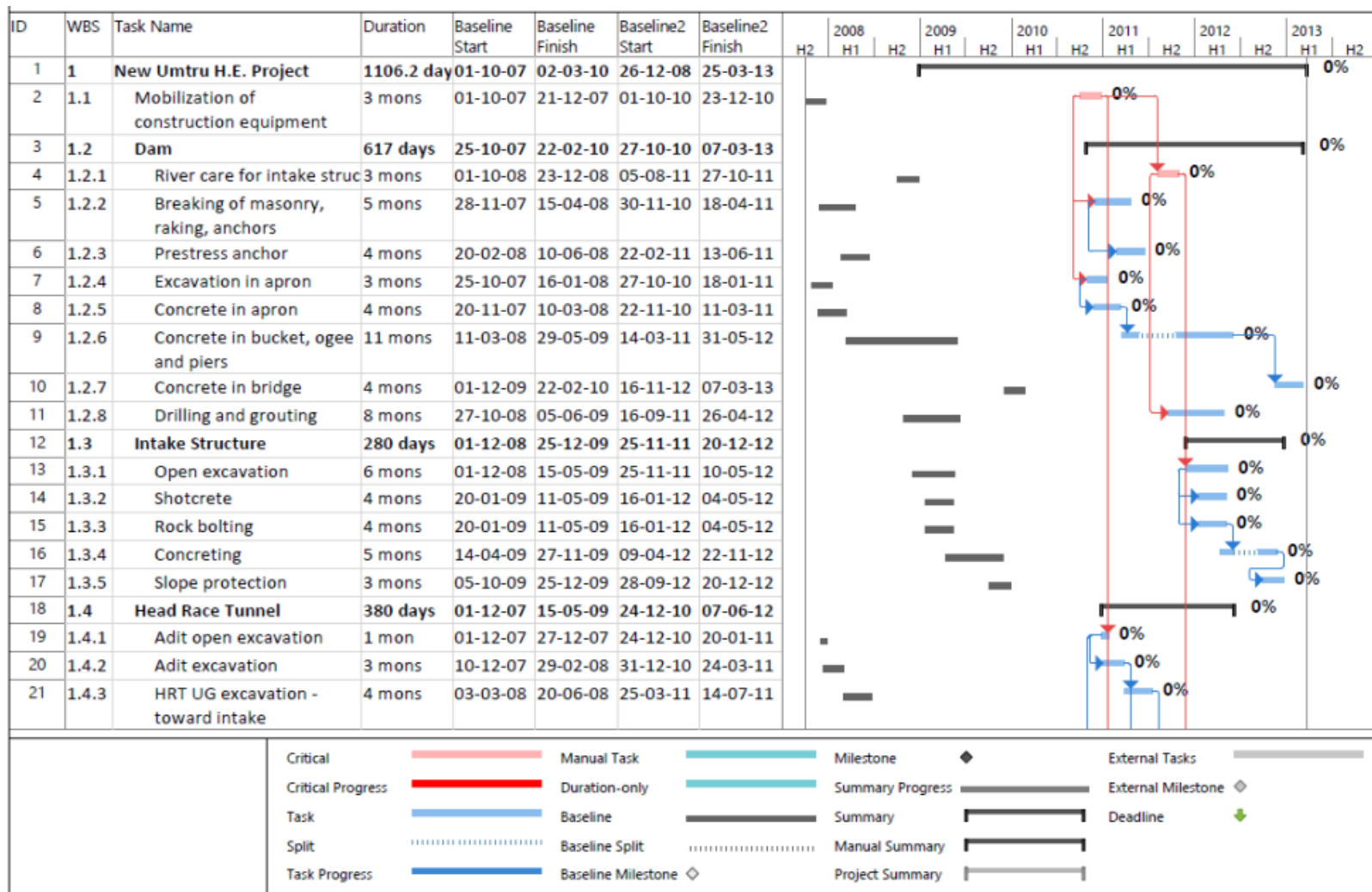


Figure 3 Revised Project Schedule of New Umtru H.E. Project - Implication of Change in Construction Methodology and Land Acquisition Delay

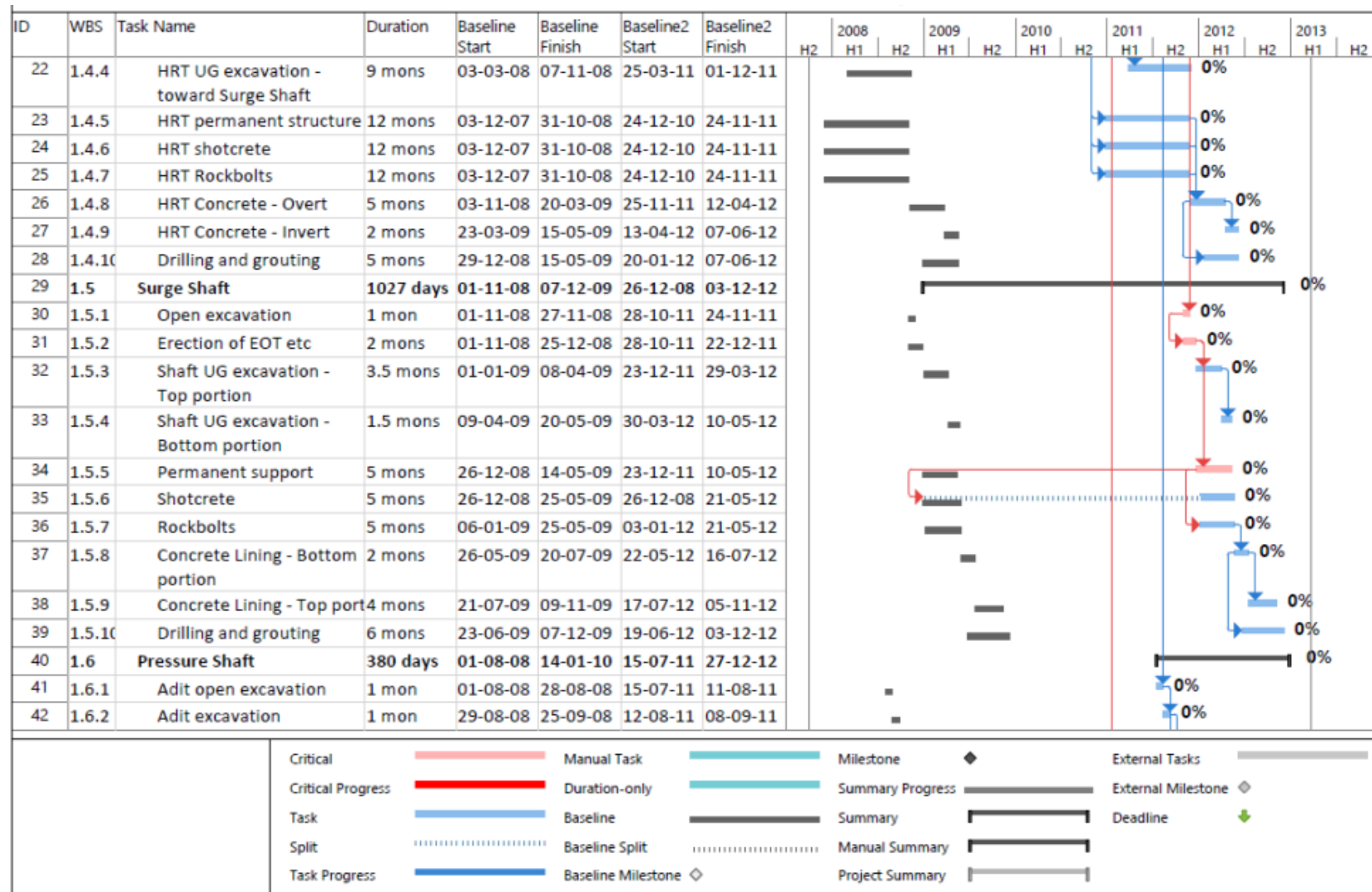


Figure 3 - Contd.



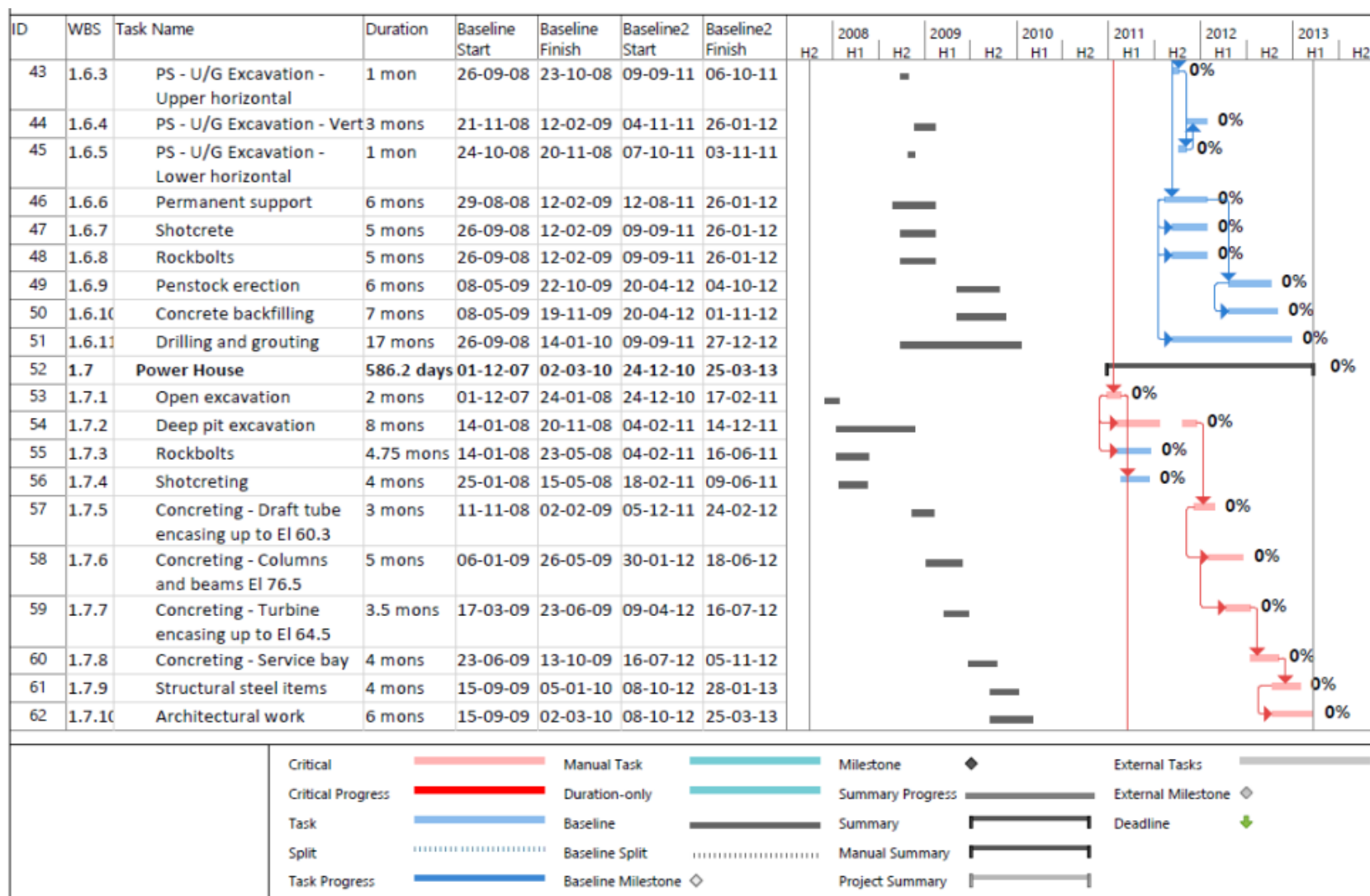


Figure 3 - Contd.

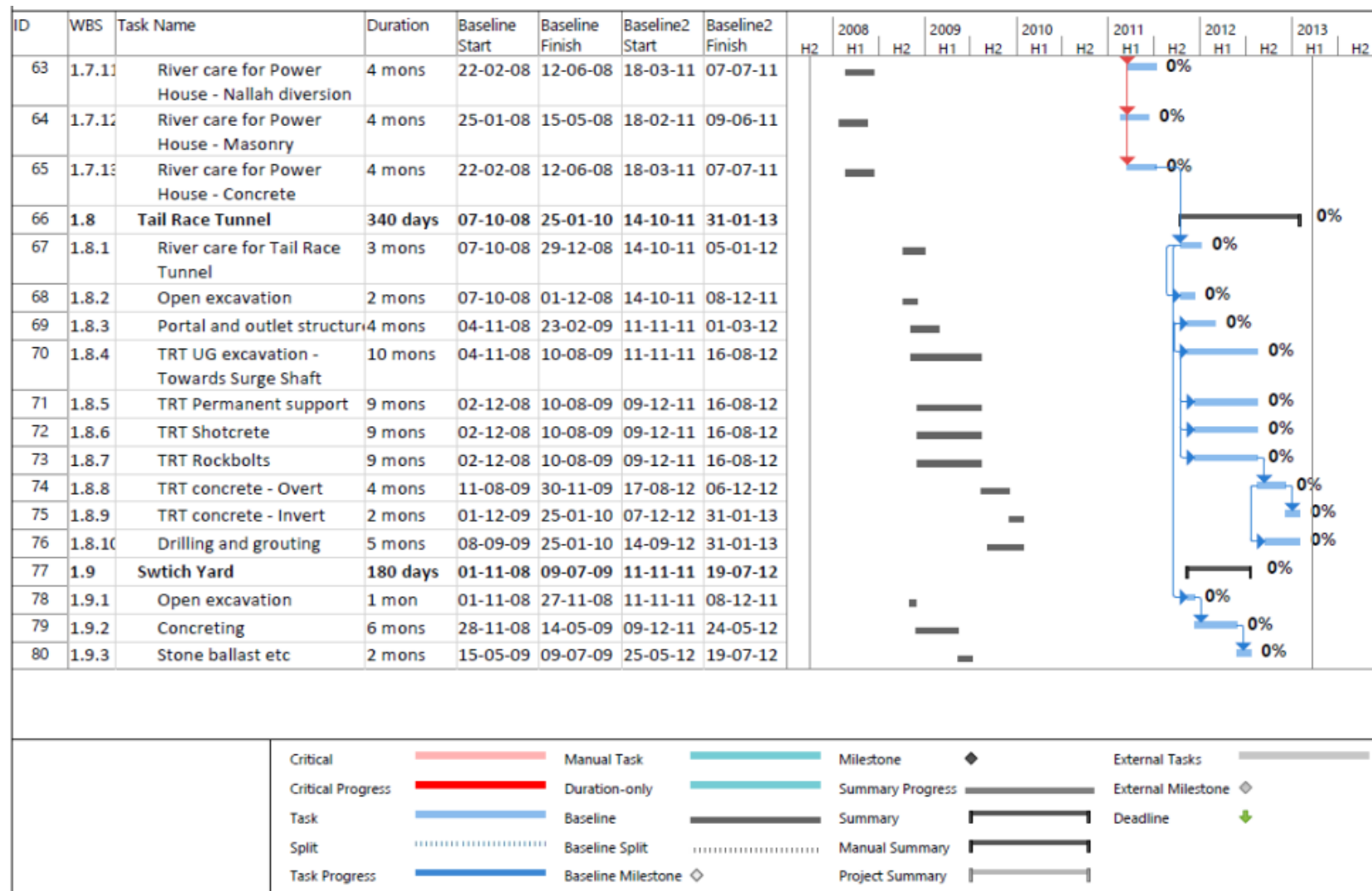


Figure 3 - Contd.

Table 24 Milestones Dates for the Key Civil Works Elements of the Project as per Revised Schedule

| WBS        | Task Name                                      | Duration           | Baseline Start  | Baseline Finish | Revised Start   | Revised Finish  |
|------------|--|--------------------|-----------------|-----------------|-----------------|-----------------|
| <b>1</b>   | <b>New Umtru H.E. Project</b>                  | <b>1106.2 days</b> | <b>01-10-07</b> | <b>02-03-10</b> | <b>26-12-08</b> | <b>25-03-13</b> |
| 1.1        | Mobilization of construction equipment         | 3 mons             | 01-10-07        | 21-12-07        | 01-10-10        | 23-12-10        |
| <b>1.2</b> | <b>Dam</b>                                     | <b>617 days</b>    | <b>25-10-07</b> | <b>22-02-10</b> | <b>27-10-10</b> | <b>07-03-13</b> |
| 1.2.1      | River care for intake structure                | 3 mons             | 01-10-08        | 23-12-08        | 05-08-11        | 27-10-11        |
| 1.2.2      | Breaking of masonry, raking, anchors           | 5 mons             | 28-11-07        | 15-04-08        | 30-11-10        | 18-04-11        |
| 1.2.3      | Pre-stress anchor                              | 4 mons             | 20-02-08        | 10-06-08        | 22-02-11        | 13-06-11        |
| 1.2.4      | Excavation in apron                            | 3 mons             | 25-10-07        | 16-01-08        | 27-10-10        | 18-01-11        |
| 1.2.5      | Concrete in apron                              | 4 mons             | 20-11-07        | 10-03-08        | 22-11-10        | 11-03-11        |
| 1.2.6      | Concrete in bucket, ogee and piers             | 11 mons            | 11-03-08        | 29-05-09        | 14-03-11        | 31-05-12        |
| 1.2.7      | Concrete in bridge                             | 4 mons             | 01-12-09        | 22-02-10        | 16-11-12        | 07-03-13        |
| 1.2.8      | Drilling and grouting                          | 8 mons             | 27-10-08        | 05-06-09        | 16-09-11        | 26-04-12        |
| <b>1.3</b> | <b>Intake Structure</b>                        | <b>280 days</b>    | <b>01-12-08</b> | <b>25-12-09</b> | <b>25-11-11</b> | <b>20-12-12</b> |
| 1.3.1      | Open excavation                                | 6 mons             | 01-12-08        | 15-05-09        | 25-11-11        | 10-05-12        |
| 1.3.2      | Shotcrete                                      | 4 mons             | 20-01-09        | 11-05-09        | 16-01-12        | 04-05-12        |
| 1.3.3      | Rock bolting                                   | 4 mons             | 20-01-09        | 11-05-09        | 16-01-12        | 04-05-12        |
| 1.3.4      | Concreting                                     | 5 mons             | 14-04-09        | 27-11-09        | 09-04-12        | 22-11-12        |
| 1.3.5      | Slope protection                               | 3 mons             | 05-10-09        | 25-12-09        | 28-09-12        | 20-12-12        |
| <b>1.4</b> | <b>Head Race Tunnel</b>                        | <b>380 days</b>    | <b>01-12-07</b> | <b>15-05-09</b> | <b>24-12-10</b> | <b>07-06-12</b> |
| 1.4.1      | Adit open excavation                           | 1 mon              | 01-12-07        | 27-12-07        | 24-12-10        | 20-01-11        |
| 1.4.2      | Adit excavation                                | 3 mons             | 10-12-07        | 29-02-08        | 31-12-10        | 24-03-11        |
| 1.4.3      | HRT UG excavation - toward intake              | 4 mons             | 03-03-08        | 20-06-08        | 25-03-11        | 14-07-11        |
| 1.4.4      | HRT UG excavation - toward Surge Shaft         | 9 mons             | 03-03-08        | 07-11-08        | 25-03-11        | 01-12-11        |
| 1.4.5      | HRT permanent structure                        | 12 mons            | 03-12-07        | 31-10-08        | 24-12-10        | 24-11-11        |
| 1.4.6      | HRT shotcrete                                  | 12 mons            | 03-12-07        | 31-10-08        | 24-12-10        | 24-11-11        |
| 1.4.7      | HRT Rockbolts                                  | 12 mons            | 03-12-07        | 31-10-08        | 24-12-10        | 24-11-11        |
| 1.4.8      | HRT Concrete - Overt                           | 5 mons             | 03-11-08        | 20-03-09        | 25-11-11        | 12-04-12        |
| 1.4.9      | HRT Concrete - Invert                          | 2 mons             | 23-03-09        | 15-05-09        | 13-04-12        | 07-06-12        |
| 1.4.10     | Drilling and grouting                          | 5 mons             | 29-12-08        | 15-05-09        | 20-01-12        | 07-06-12        |
| <b>1.5</b> | <b>Surge Shaft</b>                             | <b>1027 days</b>   | <b>01-11-08</b> | <b>07-12-09</b> | <b>26-12-08</b> | <b>03-12-12</b> |
| 1.5.1      | Open excavation                                | 1 mon              | 01-11-08        | 27-11-08        | 28-10-11        | 24-11-11        |
| 1.5.2      | Erection of EOT etc                            | 2 mons             | 01-11-08        | 25-12-08        | 28-10-11        | 22-12-11        |
| 1.5.3      | Shaft UG excavation - Top portion              | 3.5 mons           | 01-01-09        | 08-04-09        | 23-12-11        | 29-03-12        |
| 1.5.4      | Shaft UG excavation - Bottom portion           | 1.5 mons           | 09-04-09        | 20-05-09        | 30-03-12        | 10-05-12        |
| 1.5.5      | Permanent support                              | 5 mons             | 26-12-08        | 14-05-09        | 23-12-11        | 10-05-12        |
| 1.5.6      | Shotcrete                                      | 5 mons             | 26-12-08        | 25-05-09        | 26-12-08        | 21-05-12        |
| 1.5.7      | Rockbolts                                      | 5 mons             | 06-01-09        | 25-05-09        | 03-01-12        | 21-05-12        |
| 1.5.8      | Concrete Lining - Bottom portion               | 2 mons             | 26-05-09        | 20-07-09        | 22-05-12        | 16-07-12        |
| 1.5.9      | Concrete Lining - Top portion                  | 4 mons             | 21-07-09        | 09-11-09        | 17-07-12        | 05-11-12        |
| 1.5.10     | Drilling and grouting                          | 6 mons             | 23-06-09        | 07-12-09        | 19-06-12        | 03-12-12        |
| <b>1.6</b> | <b>Pressure Shaft</b>                          | <b>380 days</b>    | <b>01-08-08</b> | <b>14-01-10</b> | <b>15-07-11</b> | <b>27-12-12</b> |
| 1.6.1      | Adit open excavation                           | 1 mon              | 01-08-08        | 28-08-08        | 15-07-11        | 11-08-11        |
| 1.6.2      | Adit excavation                                | 1 mon              | 29-08-08        | 25-09-08        | 12-08-11        | 08-09-11        |
| 1.6.3      | PS - U/G Excavation - Upper horizontal         | 1 mon              | 26-09-08        | 23-10-08        | 09-09-11        | 06-10-11        |
| 1.6.4      | PS - U/G Excavation - Vertical                 | 3 mons             | 21-11-08        | 12-02-09        | 04-11-11        | 26-01-12        |
| 1.6.5      | PS - U/G Excavation - Lower horizontal         | 1 mon              | 24-10-08        | 20-11-08        | 07-10-11        | 03-11-11        |
| 1.6.6      | Permanent support                              | 6 mons             | 29-08-08        | 12-02-09        | 12-08-11        | 26-01-12        |
| 1.6.7      | Shotcrete                                      | 5 mons             | 26-09-08        | 12-02-09        | 09-09-11        | 26-01-12        |
| 1.6.8      | Rockbolts                                      | 5 mons             | 26-09-08        | 12-02-09        | 09-09-11        | 26-01-12        |
| 1.6.9      | Penstock erection                              | 6 mons             | 08-05-09        | 22-10-09        | 20-04-12        | 04-10-12        |
| 1.6.10     | Concrete backfilling                           | 7 mons             | 08-05-09        | 19-11-09        | 20-04-12        | 01-11-12        |
| 1.6.11     | Drilling and grouting                          | 17 mons            | 26-09-08        | 14-01-10        | 09-09-11        | 27-12-12        |
| <b>1.7</b> | <b>Power House</b>                             | <b>586.2 days</b>  | <b>01-12-07</b> | <b>02-03-10</b> | <b>24-12-10</b> | <b>25-03-13</b> |
| 1.7.1      | Open excavation                                | 2 mons             | 01-12-07        | 24-01-08        | 24-12-10        | 17-02-11        |
| 1.7.2      | Deep pit excavation                            | 8 mons             | 14-01-08        | 20-11-08        | 04-02-11        | 14-12-11        |
| 1.7.3      | Rockbolts                                      | 4.75 mons          | 14-01-08        | 23-05-08        | 04-02-11        | 16-06-11        |
| 1.7.4      | Shotcreting                                    | 4 mons             | 25-01-08        | 15-05-08        | 18-02-11        | 09-06-11        |
| 1.7.5      | Concreting - Draft tube encasing up to El 60.3 | 3 mons             | 11-11-08        | 02-02-09        | 05-12-11        | 24-02-12        |
| 1.7.6      | Concreting - Columns and beams El 76.5         | 5 mons             | 06-01-09        | 26-05-09        | 30-01-12        | 18-06-12        |
| 1.7.7      | Concreting - Turbine encasing up to El 64.5    | 3.5 mons           | 17-03-09        | 23-06-09        | 09-04-12        | 16-07-12        |

Contd.

Table 24 - Contd.

| WBS        | Task Name                                     | Duration        | Baseline Start  | Baseline Finish | Revised Start   | Revised Finish  |
|------------|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1.7.8      | Concreting - Service bay                      | 4 mons          | 23-06-09        | 13-10-09        | 16-07-12        | 05-11-12        |
| 1.7.9      | Structural steel items                        | 4 mons          | 15-09-09        | 05-01-10        | 08-10-12        | 28-01-13        |
| 1.7.10     | Architectural work                            | 6 mons          | 15-09-09        | 02-03-10        | 08-10-12        | 25-03-13        |
| 1.7.11     | River care for Power House - Nallah diversion | 4 mons          | 22-02-08        | 12-06-08        | 18-03-11        | 07-07-11        |
| 1.7.12     | River care for Power House - Masonry          | 4 mons          | 25-01-08        | 15-05-08        | 18-02-11        | 09-06-11        |
| 1.7.13     | River care for Power House - Concrete         | 4 mons          | 22-02-08        | 12-06-08        | 18-03-11        | 07-07-11        |
| <b>1.8</b> | <b>Tail Race Tunnel</b>                       | <b>340 days</b> | <b>07-10-08</b> | <b>25-01-10</b> | <b>14-10-11</b> | <b>31-01-13</b> |
| 1.8.1      | River care for Tail Race Tunnel               | 3 mons          | 07-10-08        | 29-12-08        | 14-10-11        | 05-01-12        |
| 1.8.2      | Open excavation                               | 2 mons          | 07-10-08        | 01-12-08        | 14-10-11        | 08-12-11        |
| 1.8.3      | Portal and outlet structure                   | 4 mons          | 04-11-08        | 23-02-09        | 11-11-11        | 01-03-12        |
| 1.8.4      | TRT UG excavation - Towards Surge Shaft       | 10 mons         | 04-11-08        | 10-08-09        | 11-11-11        | 16-08-12        |
| 1.8.5      | TRT Permanent support                         | 9 mons          | 02-12-08        | 10-08-09        | 09-12-11        | 16-08-12        |
| 1.8.6      | TRT Shotcrete                                 | 9 mons          | 02-12-08        | 10-08-09        | 09-12-11        | 16-08-12        |
| 1.8.7      | TRT Rockbolts                                 | 9 mons          | 02-12-08        | 10-08-09        | 09-12-11        | 16-08-12        |
| 1.8.8      | TRT concrete - Overt                          | 4 mons          | 11-08-09        | 30-11-09        | 17-08-12        | 06-12-12        |
| 1.8.9      | TRT concrete - Invert                         | 2 mons          | 01-12-09        | 25-01-10        | 07-12-12        | 31-01-13        |
| 1.8.10     | Drilling and grouting                         | 5 mons          | 08-09-09        | 25-01-10        | 14-09-12        | 31-01-13        |
| <b>1.9</b> | <b>Switch Yard</b>                            | <b>180 days</b> | <b>01-11-08</b> | <b>09-07-09</b> | <b>11-11-11</b> | <b>19-07-12</b> |
| 1.9.1      | Open excavation                               | 1 mon           | 01-11-08        | 27-11-08        | 11-11-11        | 08-12-11        |
| 1.9.2      | Concreting                                    | 6 mons          | 28-11-08        | 14-05-09        | 09-12-11        | 24-05-12        |
| 1.9.3      | Stone ballast etc.                            | 2 mons          | 15-05-09        | 09-07-09        | 25-05-12        | 19-07-12        |

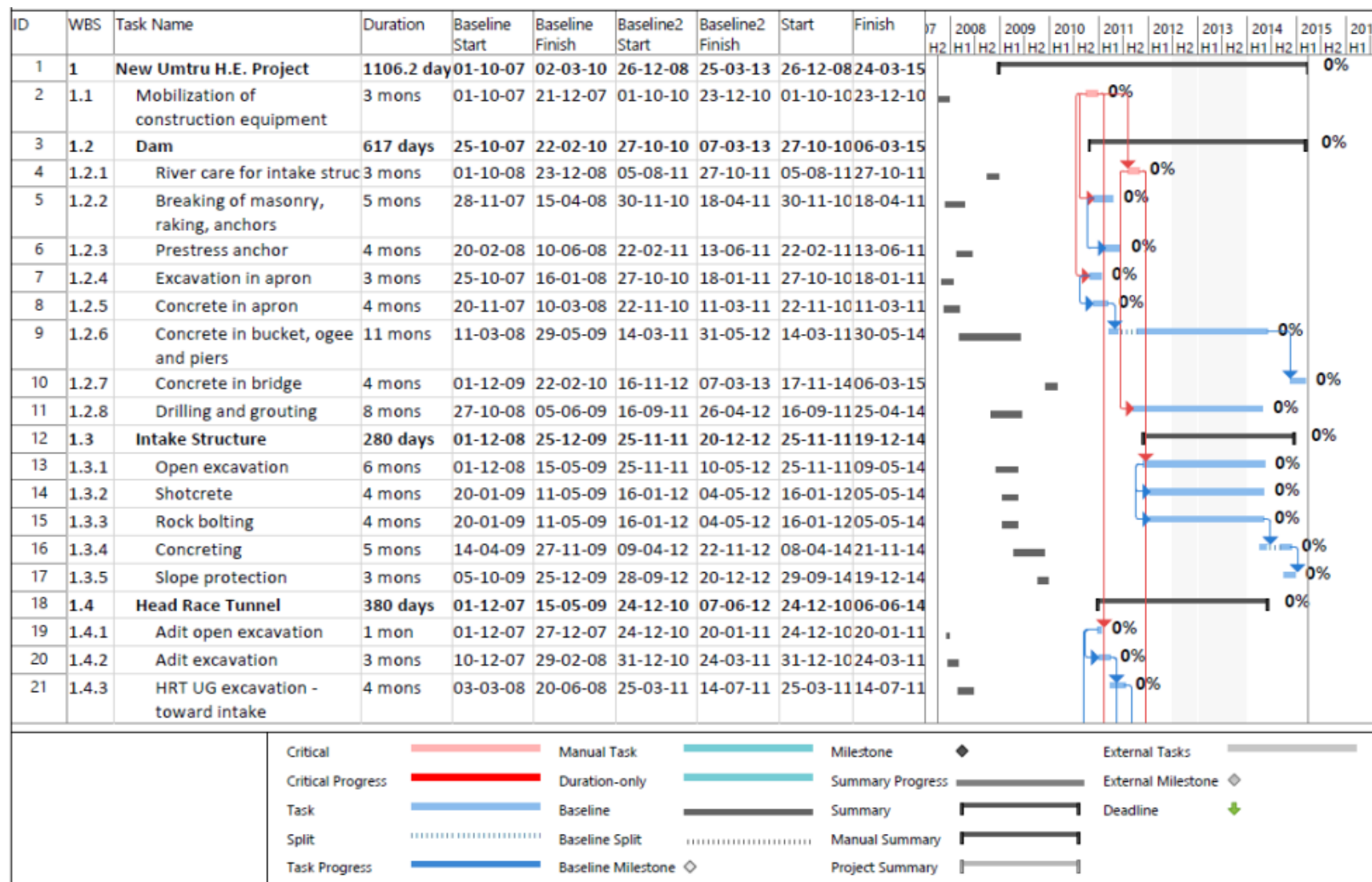


Figure 4 Revised Project Schedule of New Umtru H.E. Project - Implication of Change in Construction Methodology, Land Acquisition Delay, and Financial Closure Delay



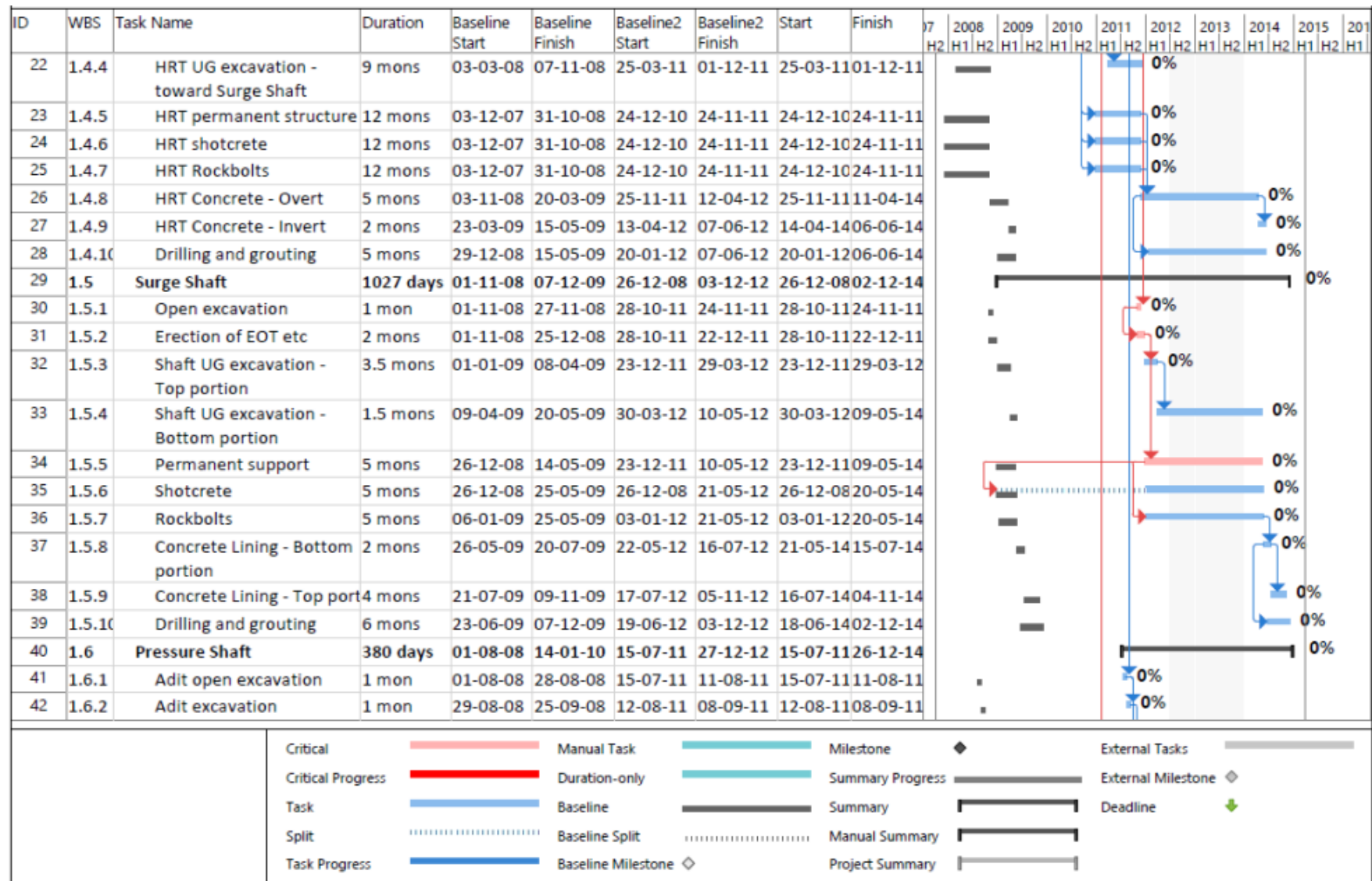


Figure 4 - Contd.

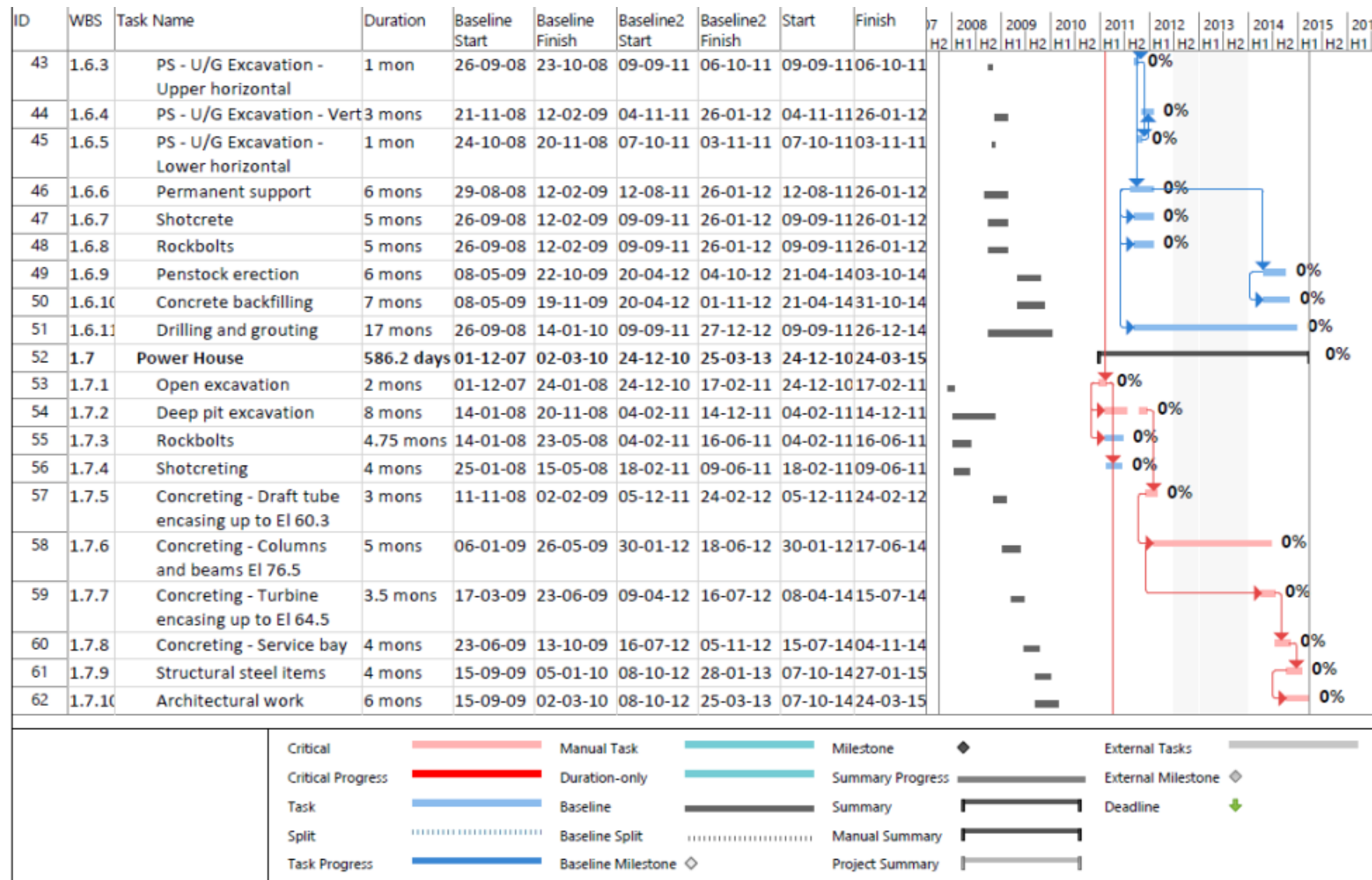


Figure 4 - Contd.



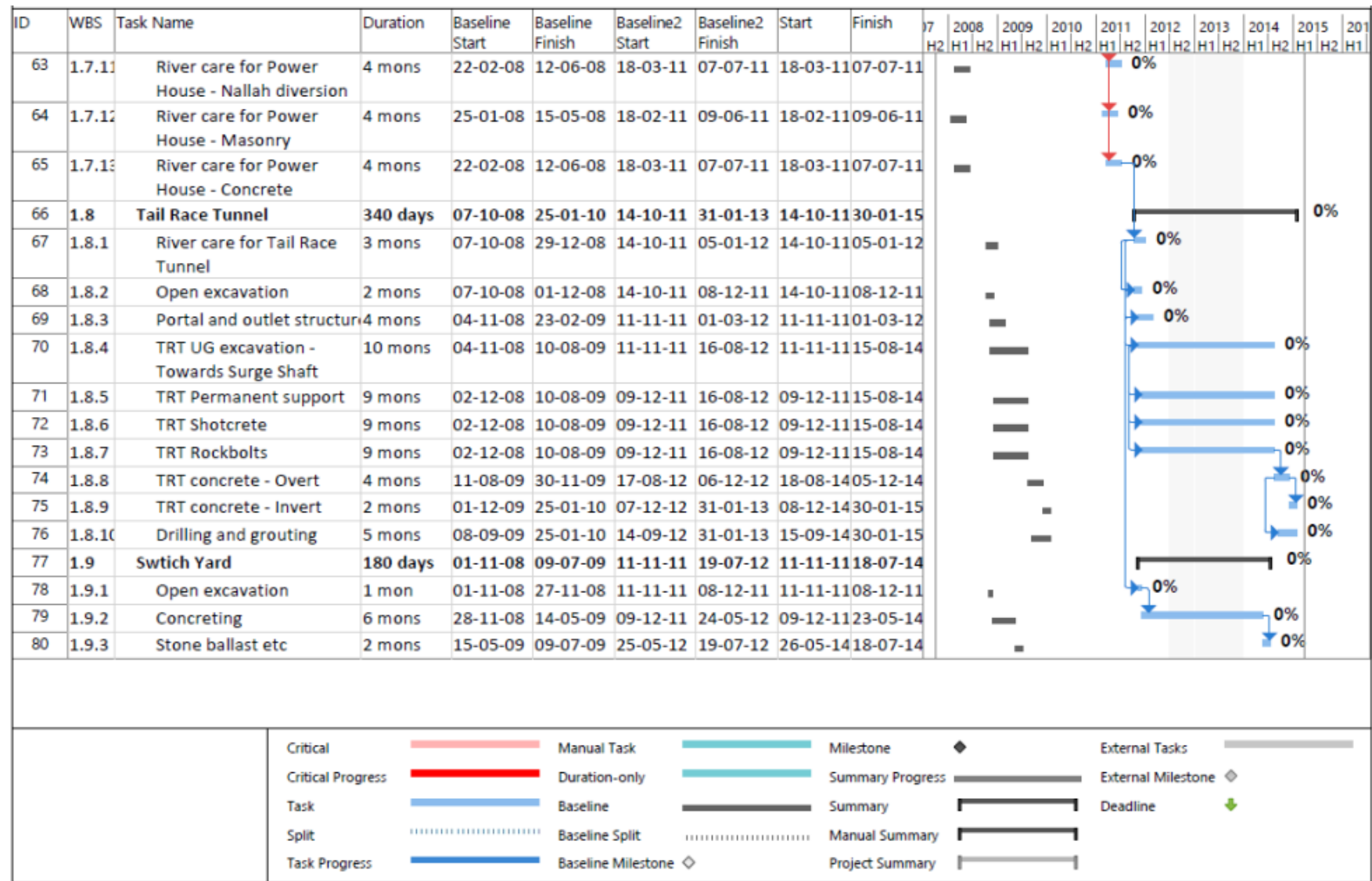


Figure 4 - Contd.

Table 25 Revised Schedule of the Project - Implications of Change in Construction Methodology, Delay in Land Acquisition and Financial Difficulties.

| WBS           | Task Name                              | Duration           | Baseline Start  | Baseline Finish | Baseline2 Start | Baseline2 Finish | Start           | Finish          |
|---------------|--|--------------------|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|
| <b>1</b>      | <b>New Umtru H.E. Project</b>          | <b>1106.2 days</b> | <b>01-10-07</b> | <b>02-03-10</b> | <b>26-12-08</b> | <b>25-03-13</b>  | <b>26-12-08</b> | <b>24-03-15</b> |
| <b>1.1</b>    | Mobilization of construction equipment | 3 mons             | 01-10-07        | 21-12-07        | 01-10-10        | 23-12-10         | 01-10-10        | 23-12-10        |
| <b>1.2</b>    | <b>Dam</b>                             | <b>617 days</b>    | <b>25-10-07</b> | <b>22-02-10</b> | <b>27-10-10</b> | <b>07-03-13</b>  | <b>27-10-10</b> | <b>06-03-15</b> |
| <b>1.2.1</b>  | River care for intake structure        | 3 mons             | 01-10-08        | 23-12-08        | 05-08-11        | 27-10-11         | 05-08-11        | 27-10-11        |
| <b>1.2.2</b>  | Breaking of masonry, raking, anchors   | 5 mons             | 28-11-07        | 15-04-08        | 30-11-10        | 18-04-11         | 30-11-10        | 18-04-11        |
| <b>1.2.3</b>  | Pre-stress anchor                      | 4 mons             | 20-02-08        | 10-06-08        | 22-02-11        | 13-06-11         | 22-02-11        | 13-06-11        |
| <b>1.2.4</b>  | Excavation in apron                    | 3 mons             | 25-10-07        | 16-01-08        | 27-10-10        | 18-01-11         | 27-10-10        | 18-01-11        |
| <b>1.2.5</b>  | Concrete in apron                      | 4 mons             | 20-11-07        | 10-03-08        | 22-11-10        | 11-03-11         | 22-11-10        | 11-03-11        |
| <b>1.2.6</b>  | Concrete in bucket, ogee and piers     | 11 mons            | 11-03-08        | 29-05-09        | 14-03-11        | 31-05-12         | 14-03-11        | 30-05-14        |
| <b>1.2.7</b>  | Concrete in bridge                     | 4 mons             | 01-12-09        | 22-02-10        | 16-11-12        | 07-03-13         | 17-11-14        | 06-03-15        |
| <b>1.2.8</b>  | Drilling and grouting                  | 8 mons             | 27-10-08        | 05-06-09        | 16-09-11        | 26-04-12         | 16-09-11        | 25-04-14        |
| <b>1.3</b>    | <b>Intake Structure</b>                | <b>280 days</b>    | <b>01-12-08</b> | <b>25-12-09</b> | <b>25-11-11</b> | <b>20-12-12</b>  | <b>25-11-11</b> | <b>19-12-14</b> |
| <b>1.3.1</b>  | Open excavation                        | 6 mons             | 01-12-08        | 15-05-09        | 25-11-11        | 10-05-12         | 25-11-11        | 09-05-14        |
| <b>1.3.2</b>  | Shotcrete                              | 4 mons             | 20-01-09        | 11-05-09        | 16-01-12        | 04-05-12         | 16-01-12        | 05-05-14        |
| <b>1.3.3</b>  | Rock bolting                           | 4 mons             | 20-01-09        | 11-05-09        | 16-01-12        | 04-05-12         | 16-01-12        | 05-05-14        |
| <b>1.3.4</b>  | Concreting                             | 5 mons             | 14-04-09        | 27-11-09        | 09-04-12        | 22-11-12         | 08-04-14        | 21-11-14        |
| <b>1.3.5</b>  | Slope protection                       | 3 mons             | 05-10-09        | 25-12-09        | 28-09-12        | 20-12-12         | 29-09-14        | 19-12-14        |
| <b>1.4</b>    | <b>Head Race Tunnel</b>                | <b>380 days</b>    | <b>01-12-07</b> | <b>15-05-09</b> | <b>24-12-10</b> | <b>07-06-12</b>  | <b>24-12-10</b> | <b>06-06-14</b> |
| <b>1.4.1</b>  | Adit open excavation                   | 1 mon              | 01-12-07        | 27-12-07        | 24-12-10        | 20-01-11         | 24-12-10        | 20-01-11        |
| <b>1.4.2</b>  | Adit excavation                        | 3 mons             | 10-12-07        | 29-02-08        | 31-12-10        | 24-03-11         | 31-12-10        | 24-03-11        |
| <b>1.4.3</b>  | HRT UG excavation - toward intake      | 4 mons             | 03-03-08        | 20-06-08        | 25-03-11        | 14-07-11         | 25-03-11        | 14-07-11        |
| <b>1.4.4</b>  | HRT UG excavation - toward Surge Shaft | 9 mons             | 03-03-08        | 07-11-08        | 25-03-11        | 01-12-11         | 25-03-11        | 01-12-11        |
| <b>1.4.5</b>  | HRT permanent structure                | 12 mons            | 03-12-07        | 31-10-08        | 24-12-10        | 24-11-11         | 24-12-10        | 24-11-11        |
| <b>1.4.6</b>  | HRT shotcrete                          | 12 mons            | 03-12-07        | 31-10-08        | 24-12-10        | 24-11-11         | 24-12-10        | 24-11-11        |
| <b>1.4.7</b>  | HRT Rockbolts                          | 12 mons            | 03-12-07        | 31-10-08        | 24-12-10        | 24-11-11         | 24-12-10        | 24-11-11        |
| <b>1.4.8</b>  | HRT Concrete - Overt                   | 5 mons             | 03-11-08        | 20-03-09        | 25-11-11        | 12-04-12         | 25-11-11        | 11-04-14        |
| <b>1.4.9</b>  | HRT Concrete - Invert                  | 2 mons             | 23-03-09        | 15-05-09        | 13-04-12        | 07-06-12         | 14-04-14        | 06-06-14        |
| <b>1.4.10</b> | Drilling and grouting                  | 5 mons             | 29-12-08        | 15-05-09        | 20-01-12        | 07-06-12         | 20-01-12        | 06-06-14        |
| <b>1.5</b>    | <b>Surge Shaft</b>                     | <b>1027 days</b>   | <b>01-11-08</b> | <b>07-12-09</b> | <b>26-12-08</b> | <b>03-12-12</b>  | <b>26-12-08</b> | <b>02-12-14</b> |
| <b>1.5.1</b>  | Open excavation                        | 1 mon              | 01-11-08        | 27-11-08        | 28-10-11        | 24-11-11         | 28-10-11        | 24-11-11        |
| <b>1.5.2</b>  | Erection of EOT etc                    | 2 mons             | 01-11-08        | 25-12-08        | 28-10-11        | 22-12-11         | 28-10-11        | 22-12-11        |
| <b>1.5.3</b>  | Shaft UG excavation - Top portion      | 3.5 mons           | 01-01-09        | 08-04-09        | 23-12-11        | 29-03-12         | 23-12-11        | 29-03-12        |
| <b>1.5.4</b>  | Shaft UG excavation - Bottom portion   | 1.5 mons           | 09-04-09        | 20-05-09        | 30-03-12        | 10-05-12         | 30-03-12        | 09-05-14        |
| <b>1.5.5</b>  | Permanent support                      | 5 mons             | 26-12-08        | 14-05-09        | 23-12-11        | 10-05-12         | 23-12-11        | 09-05-14        |
| <b>1.5.6</b>  | Shotcrete                              | 5 mons             | 26-12-08        | 25-05-09        | 26-12-08        | 21-05-12         | 26-12-08        | 20-05-14        |

Contd.

Table 25 - Contd.

| WBS    | Task Name                                      | Duration          | Baseline Start  | Baseline Finish | Baseline2 Start | Baseline2 Finish | Start           | Finish          |
|--------|--|-------------------|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|
| 1.5.7  | Rockbolts                                      | 5 mons            | 06-01-09        | 25-05-09        | 03-01-12        | 21-05-12         | 03-01-12        | 20-05-14        |
| 1.5.8  | Concrete Lining - Bottom portion               | 2 mons            | 26-05-09        | 20-07-09        | 22-05-12        | 16-07-12         | 21-05-14        | 15-07-14        |
| 1.5.9  | Concrete Lining - Top portion                  | 4 mons            | 21-07-09        | 09-11-09        | 17-07-12        | 05-11-12         | 16-07-14        | 04-11-14        |
| 1.5.10 | Drilling and grouting                          | 6 mons            | 23-06-09        | 07-12-09        | 19-06-12        | 03-12-12         | 18-06-14        | 02-12-14        |
| 1.6    | <b>Pressure Shaft</b>                          | <b>380 days</b>   | <b>01-08-08</b> | <b>14-01-10</b> | <b>15-07-11</b> | <b>27-12-12</b>  | <b>15-07-11</b> | <b>26-12-14</b> |
| 1.6.1  | Adit open excavation                           | 1 mon             | 01-08-08        | 28-08-08        | 15-07-11        | 11-08-11         | 15-07-11        | 11-08-11        |
| 1.6.2  | Adit excavation                                | 1 mon             | 29-08-08        | 25-09-08        | 12-08-11        | 08-09-11         | 12-08-11        | 08-09-11        |
| 1.6.3  | PS - U/G Excavation - Upper horizontal         | 1 mon             | 26-09-08        | 23-10-08        | 09-09-11        | 06-10-11         | 09-09-11        | 06-10-11        |
| 1.6.4  | PS - U/G Excavation - Vertical                 | 3 mons            | 21-11-08        | 12-02-09        | 04-11-11        | 26-01-12         | 04-11-11        | 26-01-12        |
| 1.6.5  | PS - U/G Excavation - Lower horizontal         | 1 mon             | 24-10-08        | 20-11-08        | 07-10-11        | 03-11-11         | 07-10-11        | 03-11-11        |
| 1.6.6  | Permanent support                              | 6 mons            | 29-08-08        | 12-02-09        | 12-08-11        | 26-01-12         | 12-08-11        | 26-01-12        |
| 1.6.7  | Shotcrete                                      | 5 mons            | 26-09-08        | 12-02-09        | 09-09-11        | 26-01-12         | 09-09-11        | 26-01-12        |
| 1.6.8  | Rockbolts                                      | 5 mons            | 26-09-08        | 12-02-09        | 09-09-11        | 26-01-12         | 09-09-11        | 26-01-12        |
| 1.6.9  | Penstock erection                              | 6 mons            | 08-05-09        | 22-10-09        | 20-04-12        | 04-10-12         | 21-04-14        | 03-10-14        |
| 1.6.10 | Concrete backfilling                           | 7 mons            | 08-05-09        | 19-11-09        | 20-04-12        | 01-11-12         | 21-04-14        | 31-10-14        |
| 1.6.11 | Drilling and grouting                          | 17 mons           | 26-09-08        | 14-01-10        | 09-09-11        | 27-12-12         | 09-09-11        | 26-12-14        |
| 1.7    | <b>Power House</b>                             | <b>586.2 days</b> | <b>01-12-07</b> | <b>02-03-10</b> | <b>24-12-10</b> | <b>25-03-13</b>  | <b>24-12-10</b> | <b>24-03-15</b> |
| 1.7.1  | Open excavation                                | 2 mons            | 01-12-07        | 24-01-08        | 24-12-10        | 17-02-11         | 24-12-10        | 17-02-11        |
| 1.7.2  | Deep pit excavation                            | 8 mons            | 14-01-08        | 20-11-08        | 04-02-11        | 14-12-11         | 04-02-11        | 14-12-11        |
| 1.7.3  | Rockbolts                                      | 4.75 mons         | 14-01-08        | 23-05-08        | 04-02-11        | 16-06-11         | 04-02-11        | 16-06-11        |
| 1.7.4  | Shotcreting                                    | 4 mons            | 25-01-08        | 15-05-08        | 18-02-11        | 09-06-11         | 18-02-11        | 09-06-11        |
| 1.7.5  | Concreting - Draft tube encasing up to El 60.3 | 3 mons            | 11-11-08        | 02-02-09        | 05-12-11        | 24-02-12         | 05-12-11        | 24-02-12        |
| 1.7.6  | Concreting - Columns and beams El 76.5         | 5 mons            | 06-01-09        | 26-05-09        | 30-01-12        | 18-06-12         | 30-01-12        | 17-06-14        |
| 1.7.7  | Concreting - Turbine encasing up to El 64.5    | 3.5 mons          | 17-03-09        | 23-06-09        | 09-04-12        | 16-07-12         | 08-04-14        | 15-07-14        |
| 1.7.8  | Concreting - Service bay                       | 4 mons            | 23-06-09        | 13-10-09        | 16-07-12        | 05-11-12         | 15-07-14        | 04-11-14        |
| 1.7.9  | Structural steel items                         | 4 mons            | 15-09-09        | 05-01-10        | 08-10-12        | 28-01-13         | 07-10-14        | 27-01-15        |
| 1.7.10 | Architectural work                             | 6 mons            | 15-09-09        | 02-03-10        | 08-10-12        | 25-03-13         | 07-10-14        | 24-03-15        |
| 1.7.11 | River care for Power House - Nallah diversion  | 4 mons            | 22-02-08        | 12-06-08        | 18-03-11        | 07-07-11         | 18-03-11        | 07-07-11        |
| 1.7.12 | River care for Power House - Masonry           | 4 mons            | 25-01-08        | 15-05-08        | 18-02-11        | 09-06-11         | 18-02-11        | 09-06-11        |
| 1.7.13 | River care for Power House - Concrete          | 4 mons            | 22-02-08        | 12-06-08        | 18-03-11        | 07-07-11         | 18-03-11        | 07-07-11        |
| 1.8    | <b>Tail Race Tunnel</b>                        | <b>340 days</b>   | <b>07-10-08</b> | <b>25-01-10</b> | <b>14-10-11</b> | <b>31-01-13</b>  | <b>14-10-11</b> | <b>30-01-15</b> |
| 1.8.1  | River care for Tail Race Tunnel                | 3 mons            | 07-10-08        | 29-12-08        | 14-10-11        | 05-01-12         | 14-10-11        | 05-01-12        |
| 1.8.2  | Open excavation                                | 2 mons            | 07-10-08        | 01-12-08        | 14-10-11        | 08-12-11         | 14-10-11        | 08-12-11        |
| 1.8.3  | Portal and outlet structure                    | 4 mons            | 04-11-08        | 23-02-09        | 11-11-11        | 01-03-12         | 11-11-11        | 01-03-12        |
| 1.8.4  | TRT UG excavation - Towards Surge Shaft        | 10 mons           | 04-11-08        | 10-08-09        | 11-11-11        | 16-08-12         | 11-11-11        | 15-08-14        |
| 1.8.5  | TRT Permanent support                          | 9 mons            | 02-12-08        | 10-08-09        | 09-12-11        | 16-08-12         | 09-12-11        | 15-08-14        |

Contd.

Table 25 - Contd.

| WBS           | Task Name             | Duration        | Baseline Start  | Baseline Finish | Baseline2 Start | Baseline2 Finish | Start           | Finish          |
|---------------|-----------------------|-----------------|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|
| <b>1.8.6</b>  | TRT Shotcrete         | 9 mons          | 02-12-08        | 10-08-09        | 09-12-11        | 16-08-12         | 09-12-11        | 15-08-14        |
| <b>1.8.7</b>  | TRT Rockbolts         | 9 mons          | 02-12-08        | 10-08-09        | 09-12-11        | 16-08-12         | 09-12-11        | 15-08-14        |
| <b>1.8.8</b>  | TRT concrete - Overt  | 4 mons          | 11-08-09        | 30-11-09        | 17-08-12        | 06-12-12         | 18-08-14        | 05-12-14        |
| <b>1.8.9</b>  | TRT concrete - Invert | 2 mons          | 01-12-09        | 25-01-10        | 07-12-12        | 31-01-13         | 08-12-14        | 30-01-15        |
| <b>1.8.10</b> | Drilling and grouting | 5 mons          | 08-09-09        | 25-01-10        | 14-09-12        | 31-01-13         | 15-09-14        | 30-01-15        |
| <b>1.9</b>    | <b>Switch Yard</b>    | <b>180 days</b> | <b>01-11-08</b> | <b>09-07-09</b> | <b>11-11-11</b> | <b>19-07-12</b>  | <b>11-11-11</b> | <b>18-07-14</b> |
| <b>1.9.1</b>  | Open excavation       | 1 mon           | 01-11-08        | 27-11-08        | 11-11-11        | 08-12-11         | 11-11-11        | 08-12-11        |
| <b>1.9.2</b>  | Concreting            | 6 mons          | 28-11-08        | 14-05-09        | 09-12-11        | 24-05-12         | 09-12-11        | 23-05-14        |
| <b>1.9.3</b>  | Stone ballast etc.    | 2 mons          | 15-05-09        | 09-07-09        | 25-05-12        | 19-07-12         | 26-05-14        | 18-07-14        |

## Interest During Construction

Funding for the project in the form of loans had structured by the implementing agency from different financial institutions at different point of time during the project implementation period. Initial debt funding for the project was financed by HUDCO. However, on revising the project cost to account for the increase in scope of work, HUDCO could not fund the additional loan component. The implementing agency then approached PFC for funding the total loan component of the project. The interest charged by the two financial institutions during the construction period is shown in Table 26 and Table 27. The IDC charged by HUDCO and PFC is INR 6,084.19 lakhs and INR 11,245.73 lakhs, respectively. Thus, the total interest during construction amount charged to the project is INR 17,329.92 lakhs.

*Table 26 Summary of Interest During Construction - HUDCO*

| Financial Year | Month / Instalment | Principal     | Repayment           | Rate of Interest | IDC Charged            |
|----------------|--------------------|---------------|---------------------|------------------|------------------------|
| 2008-09        | November 2008      | 15,00,00,000  |                     | 14%              | 74,32,345.00           |
|                | December 2008      | 2,08,15,0000  |                     | 14%              |                        |
|                | January 2009       | 2,08,15,0000  |                     | 13.50%           |                        |
|                | February 2009      | 2,08,15,0000  |                     | 12.75%-13.5%     |                        |
|                | March 2009         | 20,81,50,000  | 81,263              | 12.75%           |                        |
| 2009-10        | May 2009           | 20,80,68,737  | 1,02,609            | 11.75%-12.75%    | 2,84,95,496.00         |
|                | August 2009        | 20,79,66,128  |                     | 11.5%-11.75%     |                        |
|                | November 2009      | 20,79,66,128  |                     | 11.50%           |                        |
|                | February 2010      | 40,79,66,128  | 1,64,863            | 10.75%-11.5%     |                        |
| 2010-11        | May 2010           | 40,78,01,265  |                     | 10.50%           | 4,36,94,052.00         |
|                | August 2010        | 40,78,01,265  |                     | 10.50%           |                        |
|                | November 2010      | 40,78,01,265  |                     | 10.50%           |                        |
|                | February 2011      | 40,78,01,265  |                     | 10.5%-11.25%     |                        |
| 2011-12        | May 2011           | 72,55,01,265  |                     | 11.5%-12%        | 9,48,55,991.00         |
|                | August 2011        | 72,55,01,265  |                     | 12%-12.5%        |                        |
|                | November 2011      | 87,75,01,265  |                     | 12.5%-13%        |                        |
|                | February 2012      | 87,75,01,265  |                     | 13.00%           |                        |
| 2012-13        | 1st Instalment     | 87,75,01,265  | 33,28,417           | 13.00%           | 13,31,63,973.00        |
|                | 3rd Instalment     | 87,41,72,848  |                     | 13.00%           |                        |
|                | 5th Instalment     | 87,41,72,848  |                     | 13.00%           |                        |
|                | 6th Instalment     | 2,80,42,008   |                     |                  |                        |
|                | 7th Instalment     | 112,91,81,856 |                     | 13.00%           |                        |
|                | 8th Instalment     | 143,51,81,856 |                     |                  |                        |
| 2013-14        | May 2013           | 148,51,81,856 |                     | 13.00%           | 15,40,92,521.00        |
|                | August 2013        | 148,51,81,856 |                     | 11.75%           |                        |
|                | November 2013      | 153,51,81,856 |                     | 11.75%           |                        |
|                | February 2014      | 157,75,81,856 | 9,88,75,000         | 11.75%           |                        |
| 2014-15        | May 2014           | 147,87,06,856 | 9,88,75,000         | 13.00%           | 14,66,84,678.00        |
|                | August 2014        | 137,98,31,856 | 9,88,75,000         | 13.00%           |                        |
|                | November 2014      | 128,09,56,856 | 9,88,75,000         | 13.00%           |                        |
|                | February 2015      | 118,20,81,856 | 9,88,75,000         | 13.00%           |                        |
| <b>Total</b>   |                    |               | <b>39,55,00,000</b> |                  | <b>60,84,19,056.00</b> |

Table 27 Summary of Interest During Construction - PFC

| Financial Year | Date     | Total Loan Drawal     | Rate of interest at the time of sanction of loan | IDC Charged              |
|----------------|----------|-----------------------|--|--------------------------|
| 2014-15        | 15.10.14 | 21,00,00,000          | 13.00%   | 6,08,82,850.00           |
|                | 21.10.14 | 1,45,03,41,930        | 13.00%   |                          |
|                | 28.10.14 | 22,87,22,763          | 13.00%   |                          |
|                | 27.11.14 | 18,00,36,788          | 13.00%   |                          |
|                | 15.01.15 | 6,08,82,850           | 13.00%   |                          |
|                | 09.02.15 | 15,00,04,655          | 13.00%   |                          |
| 2015-16        | 15.04.15 | 7,03,69,134           | 13.00%   | 32,76,68,256.00          |
|                | 17.04.15 | 7,22,48,642           | 12.75%   |                          |
|                | 25.05.15 | 6,74,92,721           | 12.75%   |                          |
|                | 07.07.15 | 5,50,61,616           | 12.75%   |                          |
|                | 15.07.15 | 7,80,70,208           | 12.75%   |                          |
|                | 23.09.15 | 6,55,48,543           | 12.75%   |                          |
|                | 15.10.15 | 8,47,75,513           | 12.65%   |                          |
|                | 20.10.15 | 5,81,44,692           | 12.65%   |                          |
|                | 07.12.15 | 9,16,52,174           | 12.65%   |                          |
|                | 21.12.15 | 10,01,82,303          | 12.65%   |                          |
|                | 12.01.16 | 9,44,53,401           | 12.65%   |                          |
|                | 17.02.16 | 8,01,69,960           | 12.65%   |                          |
|                | 23.03.16 | 5,18,92,851           | 12.65%   |                          |
|                | 12.04.16 | 10,24,96,693          | 12.40%   | 59,80,86,729.00          |
| 2016-17        | 13.04.16 | 8,12,71,391           | 12.40%   |                          |
|                | 12.07.16 | 11,03,72,984          | 12.40%   |                          |
|                | 15.07.16 | 14,24,04,392          | 12.40%   |                          |
|                | 24.08.16 | 11,08,05,939          | 12.40%   |                          |
|                | 06.12.16 | 12,39,46,948          | 12.15%   |                          |
|                | 15.12.16 | 6,02,16,653           | 12.15%   |                          |
|                | 15.01.17 | 12,64,80,105          | 12.15%   |                          |
|                | 31.01.17 | 3,11,70,762           | 12.15%   |                          |
|                | 22.03.17 | 5,36,34,312           | 12.15%   |                          |
|                | 11.08.17 | 13,47,89,999          | 12.15%   | 13,79,35,263.00          |
| 2017-18        | 16.08.17 | 7,53,59,078           | 12.15%   |                          |
| <b>Total</b>   |          | <b>4,40,30,00,000</b> |  | <b>1,12,45,73,098.00</b> |

## Pre-payment Charges

HUDCO had initially sanctioned a loan of INR 15,820 lakhs for the project with security from the State Government Guarantee. After the sanctioning of the loan, the project estimate had to be revised due to change in the scope of the work, resulting in the need for an additional INR 10,000 lakhs. In order to fund this, the implementing agency then approached HUDCO to provide an additional 7,000 lakhs as enhanced loan for the project. However, the financial institution expressed its inability to fund and requested the implementing agency to take-out the funding of its sanctioned loan of INR 15,820 lakhs. The implementing agency then decided to approach PFC for pre-repayment of the existing HUDCO's loan along with all interest dues as on that date. Thus, the implementing agency had to pay an amount of INR 308.95 lakhs as pre-payment charge.

## Accrued Expenditure till March 31, 2019

The actual cost of the project that has been evaluated by accounting for the payments made to the concerned contractors for Civil Works, Electro-Mechanical Works, and payments under other heads is found to be INR 58,739.79 lakhs. However, besides the actual payment to the

contractors, the implementing agency has already incurred certain expenditures towards *Civil Works* and *Electro-Mechanical Works* which have not been paid at the time of review. This incurred expenditure towards *Civil Work* and *Electro-Mechanical Works* is INR 944.14 lakhs and INR 55.73 lakhs, respectively. Besides the incurred expenses, an amount of INR 888.01 lakhs had also been incurred towards contingent liabilities. This include the cost of land yet to be paid to the land owners (INR 224.75 lakhs), alternative road through land which is also yet to be paid (INR 80 lakhs), repairing of diversion channel (INR 15.00 lakhs), and claims by M/s Andritz Hydro Pvt Ltd. (INR 568.26 lakhs).

## Summary

The Meghalaya Power Generation Corporation Limited (MePGCL) has been entrusted with the development of New Umtru Hydro Electric Power Project 40 MW (2 x 20 MW) in Ri Bhoi district of Meghalaya. The New Umtru Hydro Electric Project (NUHEP) was built alongside the old Umtru Project with common water storage and a new dam was built at the location of the old dismantled Umtru weir of the old project to create enhanced water storage for old and new projects. The project was initially approved at a cost of INR 17,596 lakhs by CEA in December 2007 after examination of the technical and cost aspects. However, at the time of completion, the actual cost of the project has increased to INR 58,739.79 lakhs, considering only the expenses paid by the implementing agency till March 31, 2019. The break-up of this Actual Cost comprises of INR 29,437.26 lakhs towards *Civil Works*, INR 11,663.66 lakhs towards *Electro-Mechanical Works*, INR 308.95 lakhs towards *Prepayment Charges*, and INR 17,329.92 lakhs towards *Interest During Construction*.

The implementation of the project was scheduled to start from 2008. However, due to several challenges relating due to land acquisition and change in construction methodology, implementation of some of the components of the project could not be started as originally scheduled. This has resulted in changing the scope of the work beyond the scope envisaged at the approval stage. In addition to this, the project also had encountered poor geological conditions and shear zones along the alignment of some of the components of the project such as HRT and TRT. Besides the technical and social challenges, the project had also encountered financial shortage during the implementation of the project. The implications of the above-mentioned events have resulted in the inability to complete the project within the initially approved cost. Based on examination of the payments made to the contractors for various works under cost heads *Civil Works* and *Electro-Mechanical Works*, it has been observed that an amount of INR 29,437.26 lakhs and INR 11,663.66 lakhs have been paid against the approved cost of INR 11,447.39 lakhs and INR 6,148.89 lakhs, respectively. The reasons for the increase in the cost could be attributed to events that could be grouped under four categories – *Price Escalation*, *Change in Scope*, *Change in Design*, and *Over/Under Provision*. Due to variation in the prices of labour and various construction materials, the increase in *Direct Cost* has been found to be INR 3,541.31 lakhs. Out of this, the major portion of the price variation is with respect to cost head *Power Plant Civil Works* (INR 2,179 lakhs) while the implication of *Price Escalation* for cost head *Civil Works* is INR 1,361 lakhs. The implications of *Change in Scope of Work* on Actual Cost has been observed to be INR 5,876.61 lakhs. The major portion of cost overruns with respect to *Change in Scope of Work* has been relating to items such as *Dam* under major cost head *Civil Works* and *Power House Complex* under cost head *Power Plant Civil Works*. The corresponding amount of cost overruns with respect to these items of work are INR 2,869.51 lakhs and INR 1,111.12 lakhs, respectively. On account of *Change in Design*, the Actual Cost of the project has increased by INR 6,686.04 lakhs. Major portion of cost increase due to *Change in Design* has been relating to items such as *Dam* and *Intake*, and *HRT* under cost heads *Civil Works*



and *Power Plant Civil Works*, respectively. The corresponding increase in costs due to *Change in Design* are INR 3,303.50 lakhs, INR 1,162.64 lakhs, and 1,221.34 lakhs, respectively. On the other hand, works relating to various items had not been carried out as per the original specifications due to change in design and scope resulting in over-provision of INR 3,91.08 lakhs. For the Electro-Mechanical works, similar kind of cost overrun analysis could not be carried out due to difficulty in segregating the invoices for the works carried out by the firms executing/supplying the related equipment. However, considering that the project is a low head scheme, the cost of INR 11,663.6 lakhs of E&M works for 40 MW (i.e. INR 2.92 crores per MW) is quite reasonable.

The project was notionally assumed to start execution from October, 2005 and complete within 30 months. The pre-construction activities started in January, 2007 and main works started in January, 2008, after awarding the contract for *Civil Works* in December, 2007. As per the original schedule submitted by contractor, the *Civil Works* should be completed by March, 2010. However, the project had experienced extensive delay in completing the Civil Works. One of the main reasons for this extensive delay could be attributed to inclusion of several activities that were not envisaged in the initial schedule, thereby highlighting that scope of the work had undergone changes and this ultimately affect not only the cost of the project but also prevented timely completion of the project within the original project schedule. Some of the notable reasons for the change in scope are: (i) change in design flood, (ii) increase in length of non-overflow block, (iii) shifting of the intake structure, (iv) change in project layout, and (v) change in construction methodology. Besides these reasons, the project had also encountered the presence of shear zone and poor geological conditions that had resulted in the need for additional works beyond the initially envisaged scope of work. Problems in timely acquisition of land for the project had also been another reason for delay in starting of works relating to *Dam* and *Power House*. Finally, the project had also experienced severe financial constraints during the course of the project execution. In fact, the implementing agency had to change the lending agency during the course of the project execution, resulting in the inability to ensure timely funding to the project and payments to the contractors in a timely manner. As a result of these events, the project could only be completed by 2017. However, considering all these events and the time by which the project has completed, it will not be incorrect to state that the project completion time appears to be quite reasonable from the perspective of delay analysis.

The implications of the time overruns resulted in price escalation and huge expenditure towards *Interest During Construction* (INR 17,329.92 lakhs). In addition to this, on account of the need to change the lending institution during the course of the project execution, the implementing agency had to bear pre-payment charges of INR 308.95 lakhs. As a result of the afore-mentioned events, the cost of the project, considering only the payments made, has increased to INR 58,739.79 lakhs from the initially approved cost of INR 17,596.28 lakhs. Besides the payments made to the various contractors for executing the items of works under various cost heads, implementing agency has also incurred expenses which are yet to be paid to the contractors at the time of review of the actual as on March 31, 2019. This includes expenses incurred towards *Civil Work* and *Electro-Mechanical Works* of INR 944.14 lakhs and INR 55.73 lakhs, respectively. Besides the above-mentioned incurred expenses, an amount of INR 888.01 lakhs had also been incurred towards contingent liabilities. Thus, if we consider both the incurred and paid expenses, the final cost of the project will be around INR 60,627.67 lakhs.

## Key Documents Referred During Vetting

MSEB (2005). “New Umtru Hydro-Electric Project (2x20 MW) Meghalaya : Detailed Project Report.” Meghalaya State Electricity Board, Shillong.

MSEB (2007). “New Umtru Hydro-Electric Project (2x20 MW) Meghalaya : Tender Documents Package-I (Civil Works).” Meghalaya State Electricity Board, Shillong.

MSEB (2007). “New Umtru Hydro-Electric Project (2x20 MW) Meghalaya : Tender Documents Package-I (Civil Works) – Volume II, Part A, General Conditions of Contract.” Meghalaya State Electricity Board, Shillong.

MSEB (2007). “New Umtru Hydro-Electric Project (2x20 MW) Meghalaya : Tender Documents Package-I (Civil Works) – Volume II, Part B, Special Conditions of Contract.” Meghalaya State Electricity Board, Shillong.

MSEB (2007). “New Umtru Hydro-Electric Project (2x20 MW) Meghalaya : Tender Documents Package-I (Civil Works).” Meghalaya State Electricity Board, Shillong.

CEA (2008). “New Umtru Hydro-Electric Project (2x20 MW) at Ri-Bhoi District in Meghalaya under NLCPR – Examination of Technical and Cost Aspects.” Central Electricity Authority, New Delhi.

MSEB (2009). “Design of RCC Counterfort Flood Protection Wall for New Umtru (2x20 MW) H.E. Project in Dehal” Reference No. CE/O/HP&SH/T-66/PH/2009/44, Dated May 07, 2009, Meghalaya State Electricity Board, Shillong.

MSEB (2009). “Construction of New Umtru H.E. Project (2x20 MW) – Package – I (Civil Works) – Replacement of Masonry and M15 Foundation Concrete with M20/M25 Concrete” Reference No. EE/NUD-I/ T-44/2009-10, Dated November 25, 2009, Meghalaya State Electricity Board, Shillong.

MePGCL (2011). “Approval for using M<sub>20</sub>A<sub>20</sub> Grade of Concrete.” Reference No. CE/C/NUHEP/T-49(A)/2011-12/47, Dated December 16, 2011, Meghalaya Power Generation Corporation Limited, Shillong.

MePGCL (2014). “Construction of New Umtru H.E. Project (2x20 MW) - Analysis of Rates for Various Grades of Concrete.” Reference No. MePGCL/D/GEN/W-81/2007/Pt-II/71, Dated September 16, 2014, Meghalaya Power Generation Corporation Limited, Shillong.

MePGCL (2014). “Approval for Analysis of Rates for Various Grades of Concrete for the Construction of New Umtru H.E. Project (2x20 MW).” Memo No. CE/C/HP&HC/T-5/Pt-V/2014, Dated September 29, 2014, Meghalaya Power Generation Corporation Limited, Shillong.

MECL (2015). “Inter-Transference of Fund to HUDCO Ltd, Guwahati.” Reference No. ACM(II)/1335/2014/72, Dated February 13, 2015, Meghalaya Energy Corporation Limited, Shillong.

MePGCL (2015). “Correction of the Approved Revised Rates for Various Grades of Concrete for the Construction of New Umtru H.E. Project (2x20 MW).” Reference No. ACE/C/NUHEP/T-47(A)/Pt-I/2014/43, Dated February 13, 2015, Meghalaya Power Generation Corporation Limited, Shillong.

MePGCL (2015). “Revision of Rate for the Items Exceeding 30% of the BOQ.” Memo No. CE/C/HP&HC/T-5/2014/18(a), Dated January 13, 2015, Meghalaya Power Generation Corporation Limited, Shillong.

MePGCL (2016). “New Umtru H.E. Project – Analysis of Rate for Second Stage Concreting.” Memo No. CE/C/HP&HC/T-24 (Pt-IX)/2016/140(a), Dated August 08, 2016, Meghalaya Power Generation Corporation Limited, Shillong.

MePGCL (2016). “Analysis of Rate Revised for Items Exceeding 30% Above the BOQ Quantity.” Reference No. ACE/C/NUHEP/T-47(A)/Pt-I/2014-15/40, Dated December 16, 2014, Meghalaya Power Generation Corporation Limited, Shillong.

Minutes of Meeting held among MeSEB, CEA and CES on February 12, 2010 at New Umtru H.E. Project, Meghalaya.

Minutes of Meeting with M/s ITD Cementation India Limited and Meghalaya Energy Corporation Limited regarding the Construction of New Umtru H.E. Project, Dehal on August 23, 2010 in the Office Chamber of the Principal Chief Engineer (Civil) MeECL.

Latest RA Bill for Payments to M/s ITD Cementation India Limited – RA Bill No. 5 (August 2018); RA Bill No. 28 (January 2017); RA Bill No. 62 (April/May 2017); RA Bill No. 67 (April/May 2017); RA Bill No. 73 (June 2017); RA Bill No. 77 (April/May 2017).

Latest RA Bill for Payments to M/s Sew Infrastructure Limited – RA Bill No. 5 (April/May 2017); RA Bill No. 6 (April/May 2017).

Statements of expenditure relating to Electro-Mechanical Works by the Implementing Agency.

Statements of Payments made to various contractors for various items of Civil Works.

Statements of Payments made to the lending institutions towards Interest During Construction.

## References

- CEA 2015. Guidelines for formulation of detailed project reports for hydro-electric schemes, their acceptance and examination for concurrence. Revision 5.0. New Delhi: Central Electricity Authority, Government of India.
- CWC 1997. Guidelines for preparation of project estimates for river valley projects. 2<sup>nd</sup> Revision Edition. New Delhi: Central Water Commission, Government of India.