AusNet

Transmission Revenue Reset 2027 to 2032 (TRR 2027-32)

Project Planning Report: Moorabool Terminal Station Shunt Reactor Replacement Project

Date: October 2025

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1. Executive summary

One of the three 220kV shunt reactors at Moorabool Terminal Station (MLTS) is currently in an advanced state of deterioration and has an elevated risk of failure. The likelihood of failure for the No.1 220kV shunt reactor is anticipated to increase, making a $20 million investment for its replacement economically justified by 2030. The project delivery lead time is estimated to be four years, and hence AusNet plans to complete the RIT-T by end of 2026 and start the project in 2027, with all forecast expenditure falling into the 2027 to 2032 TRR period.

The No.2 500kV shunt reactor is also in an advanced state of deterioration, and its replacement is likewise economically justified. However, AusNet requires advice from AEMO and VicGrid regarding strategic options – such as potential relocation of the 500kV shunt reactor based on future network needs. Consequently, the current MLTS reactor replacement project scope reflects only the replacement of the 220kV shunt reactor.

2. Background

Moorabool Terminal Station (MLTS) is located north of Geelong in Victoria. It was commissioned in the early 1980s and forms part of the main Victorian 500 kV transmission system with transformation from 500 kV to 220 kV. It is part of the main 500 kV transmission network, which provides major transmission network services in Victoria. The 500 kV transmission backbone runs from east to west across the state and connects generation in the Latrobe Valley and western parts of Victoria with the major load centre in Melbourne. It also forms an interconnector with South Australia at Heywood Terminal Station (HYTS) as shown below.

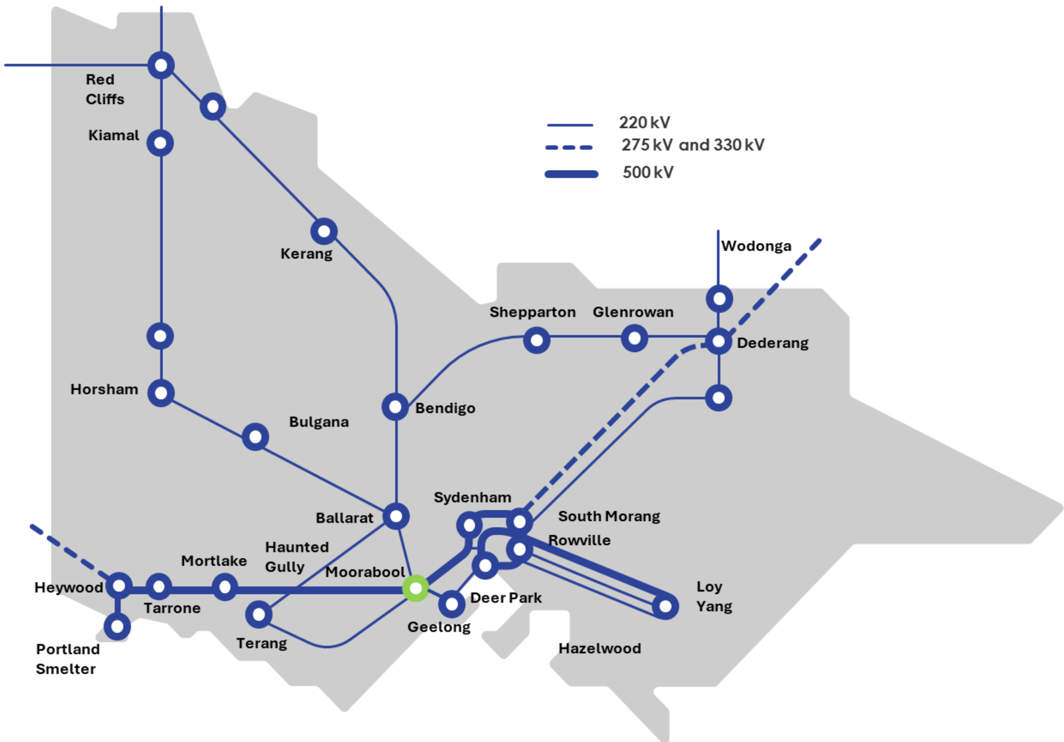

Figure 1: Victorian main transmission system

Asset Condition

AusNet has undertaken a comprehensive condition assessment of all shunt reactors at MLTS. The evaluation has determined that the No.1 220 kV shunt reactor and the No.2 500kV shunt reactor are in an advanced state of deterioration and both reactors are economically justified for replacement in the 2027-2032 TRR period. At this stage, the scope of this planning report is limited to the replacement of the No.1 220 kV shunt reactor. AusNet is currently awaiting further guidance from AEMO VIC Planning and VicGrid regarding the strategic options for the replacement of the No.2 500 kV shunt reactor, as the ongoing need for the MLTS No. 2 500kV shunt reactor at its current location is under review.

No.1 220kV Shunt Reactor

The No.1 245 kV, 121 MVAr Shunt Reactor is in an advanced deteriorated condition, and replacement is being proposed as an economical solution to manage the risk of a failure of this shunt reactor. The No.1 220 kV reactor was commissioned in 1983, and it is 42 years old. As such this reactor is reaching end of its service life.

Long term condition results for this reactor consistently show elevated levels of phenolic compounds within the insulating oil, which are typically linked to degradation in resin bonded/impregnated insulating structures. This type of degradation leads to shrinkage in the winding insulated support materials, leading to reduced clamping pressure and reduced structural integrity. This deterioration is currently the most significant factor contributing to the reactor's poor condition.

The 245 kV bushings are also in an advanced deteriorated state, demonstrating high risk due to failure of the bushing oil seals leading to internal insulation system deterioration, although the reactor's insulating oil condition remains moderate and acceptable for continued service. Please refer to the Asset Condition Report for detailed information.

Another contributing factor is the operational pattern of 245 kV reactors in the transmission network. These units are frequently switched on and off based on network requirements, rather than operating continuously. This frequent switching causes high-magnitude forces imposed on the internal winding support structures from the inrush currents, further increasing the likelihood of failure. While the bushings, insulating oil, reactor tank and cooling system are considered recoverable, the windings are not. The internal support structures for the windings show advanced deterioration, posing a significant risk of winding failure and potential catastrophic failure of the reactor. Therefore, replacement of the reactor is recommended rather than refurbishment.

Table 1 shows the forecast failure rates for the No.1 220 kV shunt reactor at MLTS.

Transformer Failure Rates	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
No.1 220 kV Shunt Reactor	0.0717	0.0742	0.0768	0.0794	0.0821	0.0848	0.0876	0.0905

Table 1: NO.1 220kV Shunt Reactor forecast failure rates

The No.2 and No.3 shunt reactors are in satisfactory condition.

3. Identified need

MLTS serves as a 500 kV switching station with 500/220 kV transformation, connecting the 500 kV backbone to the 220 kV transmission network near Geelong, as shown in Figure 1. MLTS contains two 121 MVA 500kV and three 121 MVA 220 kV shunt reactors. The ongoing need for MLTS is both demonstrated in AEMO's Integrated System Plan (ISP) and Victorian Annual Planning Report (VAPR).

The poor condition of some assets at the terminal station has increased the likelihood of asset failures. Such failures would result in prolonged outages. Without remedial action, beyond ongoing maintenance practice (business-as-usual), affected assets are expected to deteriorate further and more rapidly. Further increases in the probability of asset failure will result in a higher likelihood of impacts on transmission network users, heightened safety risks due to potential explosive failure, environmental risks, collateral damage risks, and the risk of increased costs resulting from emergency asset replacements and reactive repairs. Therefore, the 'identified need' this project intends to address is to maintain reliable transmission network services at MLTS and to mitigate risks from asset failures.

AusNet has estimated the present value of the baseline risk to be approximately $21 million over the forty-five-year period from 2025. The key risks are shown in Figure 2 with the largest components being the supply risk that will impact network users because of involuntary load shedding, and reactive asset replacement risk from increased cost when responding to an asset failure.

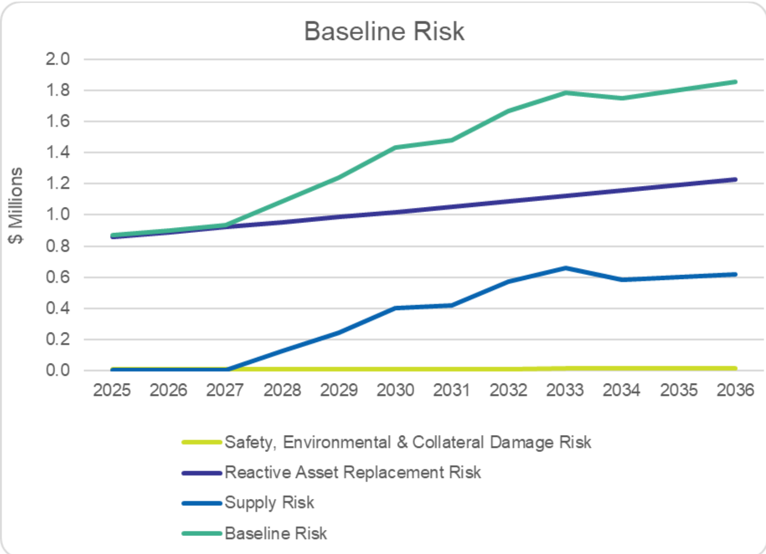

Figure 2: Baseline risk

By undertaking the options identified, AusNet Services will be able to maintain reliable transmission network services at MLTS and mitigate safety and environmental risks as required by the NER and Electricity Safety Act 1998[1].

3.1. Key inputs and assumptions

Aside from the failure rates (determined by the condition of the assets) and the likelihood of relevant consequences, AusNet Services also adopted the following assumptions to quantify the risks associated with asset failure.

Market impact and supply risk costs

AusNet Services calculated the market impact cost, which consist of increased generation cost and expected unserved energy resulting from an asset failure based on the Victoria statewide Value of Customer Reliability (VCR)[2].

[1] Victorian State Government, Victorian Legislation and Parliamentary Documents, "Electricity Safe Act 1998"
2 In dollar terms, the Value of Customer Reliability (VCR) represents a customer's willingness to pay for the reliable supply of electricity. The values produced are used as a proxy, and can be applied for use in revenue regulation, planning, and operational purposes in the National Electricity Market (NEM).

Safety risk costs

The Electricity Safety Act 1998[3] requires AusNet Services to design, construct, operate, maintain, and decommission its network to minimize hazards and risks to the safety of any person as far as reasonably practicable or until the costs become disproportionate to the benefits from managing those risks. By implementing this principle for assessing safety risks from explosive asset failures, AusNet Services uses:

- a value of statistical life[4] to estimate the benefits of reducing the risk of death;
- a value of lost time injury[5;] and
- a disproportionality factor[6].

AusNet Services notes this approach, including the use of a disproportionality factor, is consistent with the practice notes[7] provided by the AER.

Financial risk costs

As there is a lasting need for the services that MLTS provides, the failure rate-weighted cost of replacing failed assets (or undertaking reactive maintenance) is included in the assessment.[8]

Environmental risk costs

Environmental risks from plant that could impact the environment when it fails and where cleanup cost could be in the order of $30,000 per event.

4. Options assessed

AusNet Services considered both network and non-network options to address the identified need, but did not find any suitable non-network solution. The three network options are presented below.

4.1. Option 1: Replace No.1 220kV Shunt Reactor

Option 1 involves the replacement of the No.1 220 kV shunt reactor in 2030. The estimated capital cost of this option is $19 million and the change in operating and maintenance cost is negligible.

4.2. Option 2: Deferred Replacement

Option 2 is the same as Option 1, except that it defers the replacement of the No.1 220 kV Shunt Reactor to 2035 after TRR 27-32 period. However, there is increased probability of asset failure and risk for this option given the later project completion date.

4.3. Material inter-regional network impact

The proposed asset replacements at MLTS will not change the transmission network configuration and none of the network options considered are likely to have a material inter-regional network impact. A 'material inter- regional network impact' is defined in the NER as:

"A material impact on another Transmission Network Service Provider's network, which may include (without limitation): (a) the imposition of power transfer constraints within another Transmission Network Service Provider's network; or (b) an adverse impact on the quality of supply in another Transmission Network Service Provider's network."

3 Victorian State Government, Victorian Legislation and Parliamentary Documents, "Electricity Safe Act 1998"
4 Department of the Prime Minister and Cabinet, Australian Government, "Best Practice Regulation Guidance Note: Value of statistical life"
5 Safe Work Australia, "The Cost of Work-related Injury and Illness for Australian Employers, Workers and the Community: 2012-13"
6 Health and Safety Executive's submission to the1987 Sizewell B Inquiry suggesting that a factor of up to 3 (i.e. costs three times larger than benefits) would apply for risks to workers; for low risks to members of the public a factor of 2, for high risks a factor of 10. The Sizewell B Inquiry was public inquiry conducted between January 1983 and March 1985 into a proposal to construct a nuclear power station in the UK.
7 Australian Energy Regulator, "Industry practice application note for asset replacement planning"
8 The assets are assumed to have survived and their condition-based age increases throughout the analysis period.

5. Assessment approach

Consistent with the RIT-T requirements and practice notes on risk-cost assessment methodology, AusNet Services undertook a cost-benefit analysis to evaluate and rank the net economic benefits of the credible options over a 45-year period.

All options considered have been assessed against a business-as-usual case where no proactive capital investment to reduce the increasing baseline risks is made.

Optimal timing of an investment option is the year when the annual benefits from implementing the option become greater than the annualised investment cost.

5.1. Proposed scenarios and input assumptions

The robustness of the investment decision is tested using the range of input assumptions and scenarios described in the table below. This analysis involves variation of assumptions around the most likely values as per the IASR, AEMO's connection point forecast, AER latest VCR rates, and AusNet Service's best estimate of project cost and forecast asset failure rates.

Parameter	Lower Bound	Most likely (central) assumption or scenario	Upper Bound
VCR	75% of central assumption	Published VCR	125% of central assumption
Asset failure rate	75% of central assumption	Assessed failure rate	125% of central assumption
Discount rate[9]	WACC rate of a network business (3.0%)	Latest commercial discount rate from IASR (7%)	Upper Bound (10%)
Project Capital Cost	85% of estimated cost	Estimated cost	115% of estimated cost

Table 1 - Summary of input assumptions for range of scenarios

5.2. Material classes of market benefits

NER clause 5.16.1(c)(4) formally sets out the classes of market benefits that must be considered in a RIT-T. AusNet Services estimates that the classes of market benefits that are likely to be material include changes in involuntary load shedding, and changes in fuel consumption arising through different patterns of generation dispatch.

5.3. Other classes of benefits

Although not formally classified as classes of market benefits under the NER, AusNet Services expects material reduction in safety risks from potential explosive failure of deteriorated assets, environmental risks, collateral damage risks to adjacent plant, and the risk of increased costs resulting from the need for emergency asset replacements and reactive repairs by implementing any of the options.

5.4. Classes of market benefits that are not material

AusNet Services estimates that the following classes of market benefits are unlikely to be material for any of the options considered:

- Changes in costs for parties, other than the RIT-T proponent – there is no other known investment, either generation or transmission, that will be affected by any option considered.

9 Discount rates as recommended in the AEMO Inputs, Assumptions and Scenarios Report (IASR)

- Changes in ancillary services costs – the options are not expected to impact on the demand for and supply of ancillary services.
- Competition benefits – there is no competing generation affected by the limitations and risks being addressed by the options considered.

- Option value – as the need for and timing of the investment options are driven by asset deterioration; there is no need to incorporate flexibility in response to uncertainty around any other factor.

6. Options assessment

This section presents the results of the economic cost benefit analysis that has been conducted to determine the preferred option and its economic timing. All the options considered will deliver a reduction in market impact risk (including supply risk), safety risk, environmental risk, collateral risk and risk cost of emergency replacement in the event of asset failure.

Presented in Figure 3, Option 1 (Replace No.1 220kV Shunt Reactor) has the highest net benefits for most sensitivities (7 of the 9 scenarios and sensitivities considered) where input variables are varied one at a time. The two scenarios and sensitivities for which Option 1 does not have the highest net benefits are high discount rate and low asset failure rate.

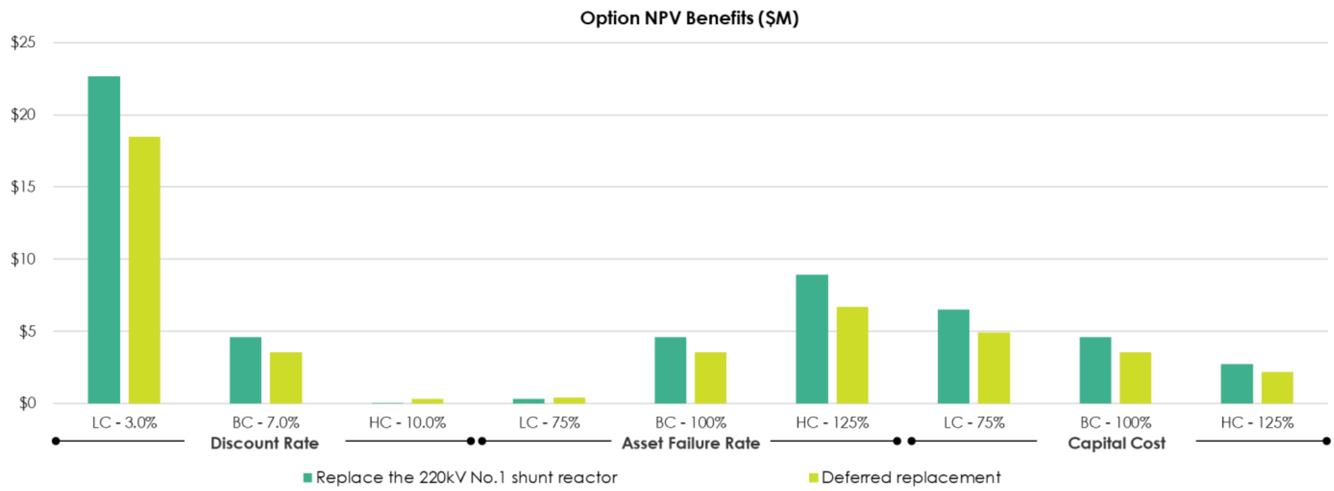

Figure 3: Option selection NPV Benefits ($M)

6.1. Preferred Option

Option 1 (Replace No.1 220 kV Shunt Reactor) is the preferred option, as Option 1 has the highest net benefits for all except two of the nine sensitivity studies (high discount rate and low asset failure rate) considered.

No non-network options have been identified, and the use of a discount rate of 10%, which is much higher than the WACC rate of a regulated network business, is thus considered inappropriate.

6.2. Optimal timing of the preferred option

This section describes the optimal investment timing of the preferred option for different assumptions of key variables. Figure 4 shows that the optimal timing of the preferred option (Option 1) is 2030 and that investment is needed within the 2027 to 2032 regulatory period.

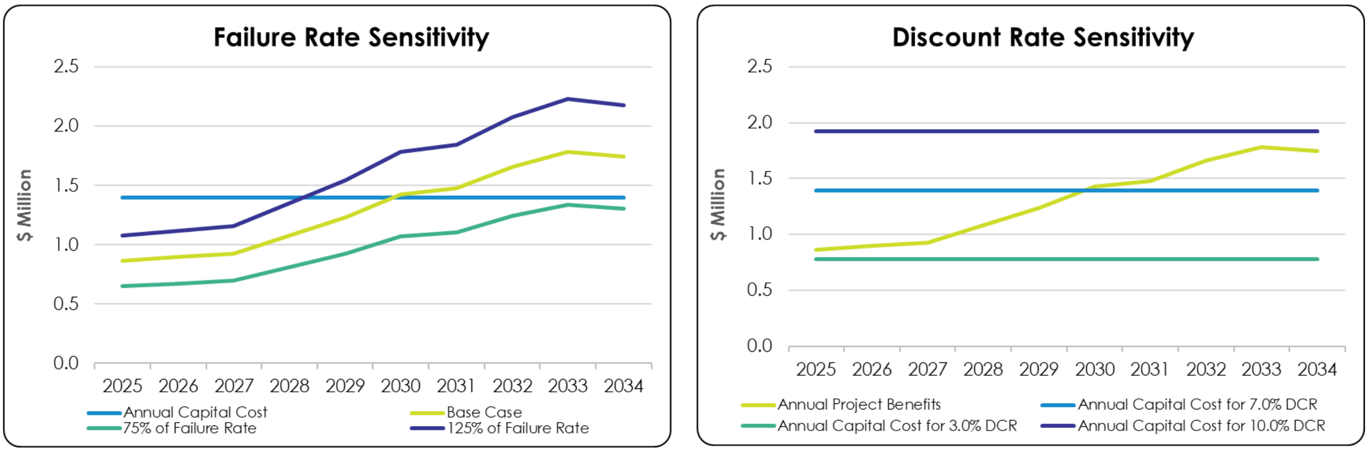

Figure 4 - Optimal investment timing sensitivity study

Figure 5 shows that the investment economic timing differs by approximately 2 years for a 15% increase in investment cost.

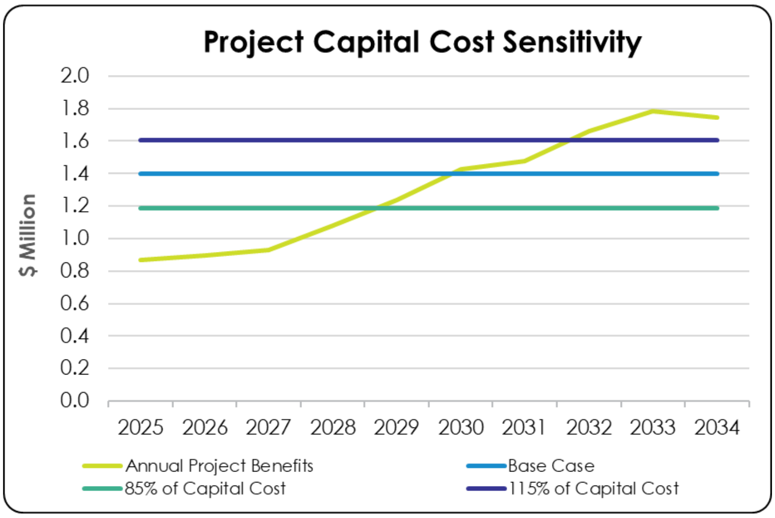

Figure 5 - Optimal investment timing sensitivity study – Capital cost

7. Conclusion

Amongst the options considered, Option 1 is the most cost-effective option to maintain reliable transmission network services at MLTS and manage safety, environmental, collateral and emergency replacement risks. The preferred option involves the replacement of the No.1 220 kV shunt reactor at MLTS.

The estimated capital cost of this option is $19 million (excluding management reserve and DDP/CDP incentives) with no material change in operating and maintenance cost. The project is economically justified by 2030 and has a delivery lead time estimated to be four years, and hence AusNet plans start the project in 2027, with all cost falling within the 2027 to 2032 regulatory control period.

8. Appendix 1: Cost Estimate

PROJECT COST SUMMARY	**UNCERTAINTY ADJUSTED ESTIMATE**
Project Number:	**TD-0015755**
Project Title:	**TD-0015755 - MLTS Reactor Replacement Rev D**
Estimate Type:	**Indicative P50 Estimate**
Revision:	**Draft Rev D**
Issued Date:	**2/10/2025**

	PROJECT EXPENDITURE FORECASTS	2027	2028	2029	2030	TOTAL
1	DESIGN & STUDIES/ASSESSMENTS	$ -	$ 832,965.19	$ 832,965.19	$ -	$ 1,665,930.39
2	INTERNAL LABOUR	$ 57,764.57	$ 346,587.42	$ 346,587.42	$ 288,822.85	$ 1,039,762.26
3	MATERIALS (AusNet Free Issue Materials)	$ -	$ 1,266,853.77	$ 3,483,847.88	$ 1,583,567.22	$ 6,334,268.87
4	PLANT & EQUIPMENT	$ -	$ 9,451.69	$ 28,355.08	$ 23,629.23	$ 61,436.01
5	CONTRACTS	$ -	$ 1,066,426.90	$ 3,199,280.71	$ 2,666,067.26	$ 6,931,774.87
6	OTHER - RISK P(50)	$ -	$ 156,385.10	$ 469,155.29	$ 390,962.74	$ 1,016,503.13
7	**PROJECT DIRECT EXPENDITURE P(50)**	**$ 57,764.57**	**$ 3,678,670.08**	**$ 8,360,191.57**	**$ 4,953,049.30**	**$ 17,049,675.52**
8	OVERHEADS	$ 2,899.78	$ 184,669.24	$ 419,681.62	$ 248,643.07	$ 855,893.71
9	FINANCE CHARGES (IDC)	$ -	$ 36,507.96	$ 435,022.50	$ 619,278.39	$ 1,090,808.85
10	**PROJECT DIRECT EXPENDITURE (SAP)**	**$ 60,664.35**	**$ 3,899,847.28**	**$ 9,214,895.68**	**$ 5,820,970.76**	**$ 18,996,378.08**
11	MANAGEMENT RESERVE [P(90)-P(50)]					$ 859,303.65
12	DDP/CDP INCENTIVES					$ 346,365.65
13	**TOTAL EXPENDITURE FOR APPROVAL (Including P(90))**	**$ 60,664.35**	**$ 3,899,847.28**	**$ 9,214,895.68**	**$ 5,820,970.76**	**$ 20,202,047.38**

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