CEEP2153 - Alice Springs Town Council Final Report

Project title: *Upgrade air conditioning system at the Civic Centre building in Todd Street, Alice Springs*

BCA Engineers Reference Number: 0686.140614.M.1

Dated: December 2014

Revision: D

Australian Government
Department of Industry and Science

This activity received funding from the Australian Government.
## Contents

1.0 Executive Summary ................................................................. 4

2.0 Project Mechanism and Structure .............................................. 5
  2.1 General .............................................................................. 5
  2.2 Application Process .......................................................... 6
  2.3 Detailed Design and Documentation ...................................... 6
  2.4 Tender Process .................................................................. 7
  2.5 Construction Phase ............................................................ 7
  2.6 Public Awareness ............................................................... 8
  2.7 Final signoff ..................................................................... 9

3.0 Energy Consumption Analysis .................................................. 9
  3.1 Energy and Cost Summary ................................................... 10

4.0 Project Budgets and Timeframes .............................................. 10

5.0 Project Objectives ................................................................. 11

6.0 Conclusion ........................................................................... 12

Appendix A – Baseline Energy Efficiency Improvement Summary .............. 13
## Report Details

<table>
<thead>
<tr>
<th>Details</th>
<th>Name</th>
<th>Company</th>
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<tbody>
<tr>
<td>Author(s)</td>
<td>Simon Costanzo</td>
<td>BCA Engineers</td>
</tr>
<tr>
<td>Reviewer</td>
<td>Mark Chmielewski</td>
<td>BCA Engineers</td>
</tr>
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<td>13&lt;sup&gt;th&lt;/sup&gt; June 2014</td>
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<td>B – Final Review Issue</td>
<td>19&lt;sup&gt;th&lt;/sup&gt; June 2014</td>
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<td>19&lt;sup&gt;th&lt;/sup&gt; June 2014</td>
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<td></td>
<td>D – Final Report</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; February 2015</td>
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</tbody>
</table>
1.0 Executive Summary

The Community Energy Efficiency Program (CEEP) is a competitive merit based grants program administered by the Australian Government. The program provides funding for Local Government and non-profit organisations to increase the energy efficiency of community use buildings, facilities and lighting. CEEP projects also promote behaviour change and improved energy management practices, and they make the business case for broader uptake of these technologies by industry, local government and community groups.

Alice Springs Town Council (ASTC) was selected for funding under Round 2 of the CEEP for the Alice Springs Civic Centre New Chiller Installation project on the basis of the following objectives:

- Improve the ability of the existing central thermal plant to respond to changing building loads at times of extreme ambient conditions.
- To reduce the energy consumption of the building by reducing periods of operation of the central thermal plant (warm-up and cool-down prior to occupants entering the building).
- To reduce energy consumption by eliminating the use of portable fans and heaters to achieve occupant comfort in extreme temperature.
- To reduce water consumption by minimising the use of cooling towers.
- To improve reliability of the system by providing a Chilled water system that continues to operate within design requirements in extreme temperatures to enable to building to continue to be occupied by Staff and Public alike.
- To demonstrate to the Public that Commonwealth and Local Governments are actively working in partnership to make reasonable attempts to reduce their environmental impact.

The project had an original budget and signed funding agreement for a total of $273,200 + GST. This included funding of $130,850 from the Australian Government through the Community Energy Efficiency Program with the remaining amount of $142,350 + GST being funded directly by ASTC.

ASTC have been able to achieve an overall energy saving for the building of 5.1% in comparison to the 6.4% estimated at the commencement of the project. As a result, the overall payback is estimated to have increased from 9 to 10 years based on data collected during three months of operation.

We do however anticipate that due to consumption data trending downwards when compared to previous years, additional savings over and above the 5.1% could be expected based on the extreme months of operation where the previous central thermal plant failed to cope and operated inefficiently.

Every attempt has been made to increase the level of public awareness associated with this project though public notification and media reports. Through these means, the project team believes we have successfully conveyed the message of all stakeholders that we are trying to reduce the environmental footprint of community use buildings.

The views expressed herein are not necessarily the views of the Commonwealth of Australia, and the Commonwealth does not accept responsibility for any information or advice contained herein.
2.0 Project Mechanism and Structure

This section provides a summary of the mechanisms put in place as part of this project, and indicates what structures and roles were played by the relevant stakeholders involved with the project.

2.1 General

The objectives of CEEP are to:

- Support a range of local councils and community organisations to increase the energy efficiency of different types of non-residential council and community use buildings, facilities and lighting,
- Demonstrate and encourage the adoption of improved energy management practices within councils, organisations and the broader community.

CEEP provided the ASTC the opportunity to apply for a grant for this project on the basis of the following objectives:

- Improve the ability of the existing central thermal plant to respond to changing building loads at times of extreme ambient conditions.
- To reduce the energy consumption of the building by reducing periods of operation of the central thermal plant (warm-up and cool-down prior to occupants entering the building).
- To reduce energy consumption by eliminating the use of portable fans and heaters to achieve occupant comfort in extreme temperature.
- To reduce water consumption by minimising the use of cooling towers.
- To improve reliability of the system by providing a Chilled water system that continues to operate within design requirements in extreme temperatures to enable building to continue to be occupied by Staff and Public alike.

The objectives nominated by ASTC align with the fundamental objectives of CEEP in the following ways:

- Commonwealth and Local governing bodies working in partnership to increase the energy efficiency of council and community use buildings via improved air conditioning system efficacy and efficiency.
- Communicating to the public what activities are being undertaken, and what the overall benefit to the environment and community will be as a result.

In order to achieve the increase in energy efficiency and reliability of systems within the building, the central thermal plant was reconfigured and additional active plant installed to operate as the primary cooling system. The secondary heating system was also reconfigured in case of major failure of existing equipment. The new technology and methodology consisted of the following:

- New air-cooled chiller plant that was more resilient to ambient temperature and humidity which was affecting the performance of existing plant
- Integrated control systems associated with the chiller which are capable of responding to ambient conditions to adjust chilled and heating hot water set-points to reduce power consumption
- Reviewing the time scheduling of the centre to reduce the number of operating hours of equipment as a result of the increase performance and reliability of the installed system
- Providing energy consumption monitoring systems so that energy consumption can be quantified and interrogated for further future improvement
- Use of non-ozone depleting refrigerants on all new equipment
2.2 Application Process

The ASTC identified that there was potential in the CEEP program to assist in reducing the energy consumption and improving the reliability of central thermal plant associated with the Alice Springs Civic Centre. It was acknowledged by the ASTC that the existing central thermal plant was performing well below its original design specifications and had high on-going maintenance costs. Performance and reliability of the existing systems were also impacting of the possible use of public spaces of the centre in times of extreme weather.

The ASTC engaged BCA Engineers to complete an assessment of the existing air conditioning and central thermal plant system including the following:

- Review of condition, capacity and compliance of the existing systems with relevant codes and standards
- Review the design and capacity of the existing equipment and reticulation systems to identify what components would be suitable for continued use
- Review of the existing control systems and possible changes to improve system efficiency and reliability
- Review of air conditioning options available to reduce energy consumption and improve reliability
- Recommendations of air conditioning systems which would suit the nature of the building and associated plant
- Net cost estimates associated with the upgrade of the systems

The ASTC in collaboration with BCA Engineers then completed and submitted the Application forms for a grant under the CEEP for the proposed upgrade of air conditioning central thermal plant associated with the Civic Centre building.

After review, notification was given that the project was successful and ASTC engaged BCA Engineers as the Principal Consultant to complete the detailed design and documentation of the proposed systems, review tender submissions and complete contract administration for the project.

2.3 Detailed Design and Documentation

On engagement, BCA Engineers mobilised to complete the following tasks:

- Complete site inspections to complete architectural layouts of the existing building including section details
- Perform site inspections to complete detailed drawings of existing air conditioning and central thermal plant so that any retained items could be coordinated with or modified to suit (no existing as-built drawings were available)
- Obtain detailed selections from multiple air conditioning equipment manufacturers to identify the most suitable systems for the building
- Compile preliminary drawings and technical specifications for review by the ASTC
- Compile Tender drawings and technical specifications ready for issue to the market by the ASTC

As part of the process, BCA Engineers also engaged additional sub-consultants to complete the following as part of the building regulations:

- Building Certifiers to obtain Permits to Build and Occupy
- Structural Engineers to confirm structural adequacy of the support structure for the proposed systems

Once completed, detailed Tender documents were provided to the ASTC for release to the market as part of the Tender Process.
2.4 Tender Process

The Tender documents were uploaded on the ASTC website and public notification was given via the local newspaper. A four (4) week tender period was given for contractors to submit their prices for the project in accordance with ASTC Tender requirements.

At the close of Tender, all submissions were opened and reviewed by the Tender Review Panel assembled for this particular project which included representatives from both ASTC and BCA Engineers. The Tender submissions were reviewed for a number of items, including overall cost, support of local businesses and technical compliance to name just a few.

On completion of the review, the tender sum was in-line with project budgets and the project was awarded to a Managing Contractor.

2.5 Construction Phase

The Managing Contractor was responsible for organising and administering all elements of the construction side of the project within and around the Civic Centre site including:

- Providing construction programs with regular updates to reflect changes in on-site conditions or latent conditions
- Controlling access to work areas and setting up control cordons to prevent unauthorised access in accordance with WH&H requirements
- Maintaining security to the building at all times
- Ordering all equipment in accordance with technical documentation
- Briefing, inducting and controlling all nominated sub-contractors throughout the construction phase
- Completing all demolition and installation in accordance with the detailed documentation
- Controlling waste removal from the site with disposal in accordance with local requirements
- Identifying any concerns for review by the ASTC and BCA Engineers where applicable
- Providing any 'Requests for Information' to BCA Engineers with sufficient time to review so as not to delay construction
- Provision of sufficient warning to permit inspections for quality of workmanship with sufficient notice
- Submitting progress claims for payment to reflect works completed

BCA Engineers' engagement included the following to ensure the quality of workmanship and ensure that deadlines were being adhered to:

- Attendance at meetings on-site as required
- Reviewing samples provided by the Contractor relating to the mechanical and electrical services
- Review of shop drawings provided by the Contractors relating to the mechanical and electrical services
- Responding to Contractors 'Request for information'
- Providing Engineer’s instructions as required
- Review installation of works at multiple stage throughout construction and providing inspection reports relating to the works
- Review 'Operating and Maintenance' manuals relating to the building services
- Witnessing during the commissioning process
- Submission of all report required to the CEEP for review and sign-off
2.6 Public Awareness

At the completion of construction, the ASTC provided public announcements to advise the public of what works had been completed and what the implications were in terms of energy and carbon equivalent savings. These public announcements took the following forms:

- Posters located in multiple locations around the Civic Centre
- An article on the ASTC website
- A press conference arranged by the ASTC for the Mayor to address the benefits of the scheme and installed system

The press conference was attended by local media, with notable attendance by ABC Radio, and the Centralian Advocate which published the article below. We note that the Centralian Advocate has a circulation of 7000 readers from the SA Border to Tennant Creek.

Since the completion of construction, there has been a significant reduction in the number of complaints associated with occupied areas of the building (both Council Staff and Public) with temperatures remaining in an acceptable range for the vast majority of the time unlike previous experience.

The Council Chambers experienced unacceptable temperature control in the past, in particular in shoulder seasons where there was a demand for cooling in the day for the whole precinct, but heating at night for the Chambers. The original air conditioning configuration was unable to respond
quickly to these requirements, with meetings often being conducted in very cold or warm conditions. The new configuration responds rapidly to such requirements with vastly improved conditions.

The way in which the system operates as a result of the works is also vastly superior to the former system. The unmistakable ‘high pitched whine’ of the old chiller located to the southern end of the property used to echo throughout the night to ensure that the building was at acceptable occupiable temperature in the morning. As designed, the new chiller which is vastly quieter than the old chiller and only starts fifteen minutes before the first employees enter the building to achieve the same outcome. The decrease in operating hours has assisted in the reduction in energy consumption. The ASTC are also evaluating the chilled and heating hot water temperatures serving the building. In periods of mild weather, it is possible to increase chilled water temperatures to reduce the energy input to the system while still providing sufficient cooling. This is being trialled by ASTC staff to gain a sense of what can be achieved with minimal impact on occupants.

2.7 Final signoff

At the completion of construction, BCA Engineers completed a final inspection and provided a final defects list indicating items requiring rectification prior to closure of the project. Once completed, BCA Engineers Issue certification Section 40’s for construction associated with Mechanical Services and liaised with Building Certifier to obtain Permits to Occupy in accordance with NT Regulations.

3.0 Energy Consumption Analysis

In order to assess energy consumption improvements as a result of the new chiller installation, we have waited approximately eight months for a time when there is a demand for cooling only on the site. During the shoulder and summer months, the boiler on site is turned off as there is no call for heating in the building. During these months, conditioning of the building is completed solely by the chiller which provides chilled water to all air handling systems within the building.

For our analysis, we have reviewed the months of September, October and November for the last three years as a sample for comparison of energy consumption for the site. While this is only a three month period, we believe this will provide a fair assessment based on the data available which can then be extrapolated across the months where the chiller operates.

<table>
<thead>
<tr>
<th>Reading Period</th>
<th>Reading (kWhr)</th>
<th>2012/2013 Average consumption (kWhr)</th>
<th>2014 consumption (kWhr)</th>
<th>Percentage Reduction in Energy Consumption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 2012</td>
<td>27202*</td>
<td>28808</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 2013</td>
<td>30414*</td>
<td>26072</td>
<td>26072</td>
<td>9.5</td>
</tr>
<tr>
<td>September 2014</td>
<td>26072*</td>
<td>31981</td>
<td>31981</td>
<td>4.4</td>
</tr>
<tr>
<td>October 2012</td>
<td>31962*</td>
<td>32000</td>
<td>32000</td>
<td></td>
</tr>
<tr>
<td>October 2013</td>
<td>32000*</td>
<td>30574</td>
<td>30574</td>
<td>19.8</td>
</tr>
<tr>
<td>October 2014</td>
<td>30574*</td>
<td>40335</td>
<td>40335</td>
<td></td>
</tr>
<tr>
<td>November 2012</td>
<td>36289*</td>
<td>38312</td>
<td>38312</td>
<td></td>
</tr>
<tr>
<td>November 2013</td>
<td>38312</td>
<td>30696</td>
<td>30696</td>
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<tr>
<td>November 2014</td>
<td>30696*</td>
<td>30696</td>
<td>30696</td>
<td>11.2</td>
</tr>
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</table>

* taken from actual billing data for the site

Table 1 – Energy Consumption for the site with percentage savings
Based on the figures above, we have applied the average percentage reduction in energy consumption for months of the year where the chiller will be operating (August – April) of 11.2%. We assume that the energy consumed through natural gas will remain unchanged. The electrical energy reduction of 11.2% corresponds to a reduction in electricity consumption of 27,000kWhr for these months.

We note that the results for November 2014 are very promising and indicate significant energy reduction at time of peak ambient temperatures. We suspect that for the extreme weather months, the site will experience reduction in consumption similar to this given historical operating practices of air conditioning systems.

3.1 Energy and Cost Summary

The summary below provides for comparison of estimated energy consumption for the existing building configuration prior to construction and at completion of construction.

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>Measured and Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Energy Usage</td>
<td>427,100 kWhr (electrical) + 481MJ (natural gas)</td>
<td>400,100 kWhr (27,000kWhr reduction in electricity) + 481MJ (natural gas)</td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>741 MJ/m² per annum</td>
<td>705 MJ/m² per annum</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>48 MJ/m² per annum</td>
<td>36 MJ/m² per annum</td>
</tr>
<tr>
<td>Actual Cost of Activity</td>
<td></td>
<td>$273,200 + GST</td>
</tr>
<tr>
<td>Estimated Cost Savings</td>
<td>$10,600 (based on 18.87c/kWhr) + $20,000p.a. maintenance costs</td>
<td>$7,400 (based on 27.5c/kWhr actual rate) + $20,000p.a. maintenance costs</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>9 years (based on 18.87c/kWhr)</td>
<td>10 years (based on 27.5c/kWhr)</td>
</tr>
</tbody>
</table>

Table 2 – Air Conditioning Energy Consumption Summary

As can be seen from Table 2 above, we have been able to achieve an overall energy saving for the building of 5.1% in comparison to the 6.4% estimated at the commencement of the project. As a result, the overall payback is estimated to have increased from 9 to 10 years.

4.0 Project Budgets and Timeframes

The project had an original budget and signed funding agreement for a total of $273,200 + GST. This included funding of $130,850 from the Australian Government through the Community Energy Efficiency Program with the remaining amount of $142,350 + GST being funded directly by ASTC.

While we are aware of the challenges associated with completing construction projects in remote locations and allowances were made in the project timelines, the project still incurred an extension in the order of two (2) months. The main contributing factors which caused this delay included the following:

- Limited and seasonal labour resources available in Alice Springs, especially over the summer months and Christmas holiday period
- Distance from major population centres and delays in transportation as result of these distances

For any future projects we will need to make further allowances to reduce the risk of delays impacting on project schedules. For projects where specific items of plant with long lead times are
required, such as chillers and boilers, these could possibly be pre-purchased by the Client prior to the tender period and be made available to the successful contractor during the construction period. It would be possible to save approximately four to six weeks by doing this.

Despite delays, the project was still delivered on budget and in accordance with the technical design documentation.

5.0 Project Objectives

A significant objective of the project was to save the consumption of energy across the site. As a result of this project, we estimate a total energy saving of 5.1% will be experienced based on three months of measured data compared to previous years. We do however anticipate that additional savings over and above the 5.1% could be expected based on the extreme months of operation there the previous central thermal plant failed to cope and operated inefficiently.

There have been clear advantages to the installed systems that are already apparent and which are in-line with the intent of the Community Energy Efficiency Program (CEED) such as the following:

- Historically, the cooling elements of the central thermal plant have been left on for extended periods prior to occupancy to ensure that the building is at design temperature when occupants walk into offices and meeting rooms in the morning. In extreme periods, the central thermal plant has been required to operate on a 24 hour per day basis. The new chiller has been programmed to commence providing chilled water to the site 30 minutes before the first occupant arrives at the building. The chiller has capacity to pull the internal temperatures within the building to specified temperatures within this 30 minute period. The need to operate central plant for extended and even on a 24 hour basis is no longer required.
- The use of portable fans used by occupants to cope with the erratic internal temperatures experienced under the previous system. While a few occupants still desire to have additional airflow as a matter of preference, the internal temperatures are vastly improved reducing the need for fans across the board as previously experienced.
- The internal control systems associated with the new plant are capable of learning the performance of the building is impacted by ambient conditions, and then respond by modifying water temperatures to reduce the energy consumption of the system while maintaining performance. The system is still in a state fine-tuning to further improve performance.
- The use of these technologies can be showcased and indicate the advantages of using air cooled systems over water cooled, especially when local water quality issues and ambient conditions need to be taken into account.
- The new chiller installation has allowed the Council and Public areas of the building to be occupied during the temporary hot water generator failure. Given the cold temperature recently experienced in Alice Springs, inability to use the central plant would have rendered the occupied areas of the building well outside the design conditions and therefore unsuitable for occupancy.
- Although we are unable to substantiate it, we have been advised that complaints from occupant have reduced significantly indicating that internal conditions have been vastly improved.

One of the additional major benefits of the project has been that the Civic Centre now has redundancy in its air conditioning systems for both heating and cooling. Previously, any failure or maintenance required the air conditioning system to be turned off resulting in intolerable internal conditions. The ASTC now has back-up systems which will improve reliability of the facility as a whole.
This project achieved the fundamental objectives of CEEP by delivering a project that reduced energy consumption of this considerable community use building. Through notifications to the Public and local media, the ASTC were able to advise the Public what was being undertaken, and what the benefits to the environment and Public would be.

The support of the CEEP in this project has encouraged the ASTC to see the long term advantage of adopting improved energy management practices within their properties and there have been additional studies and changes (both big and small) in their assets to increase the energy efficiency of their portfolio.

6.0 Conclusion

The key aims of the project were to achieve the following objectives:

- Improve the ability of the existing central thermal plant to respond to changing building loads at times of extreme ambient conditions.
- To reduce the energy consumption of the building by reducing periods of operation of the central thermal plant (warm-up and cool-down prior to occupants entering the building).
- To reduce energy consumption by eliminating the use of portable fans and heaters to achieve occupant comfort in extreme temperature.
- To reduce water consumption by minimising the use of cooling towers.
- To improve reliability of the system by providing a Chilled water system that continues to operate within design requirements in extreme temperatures to enable to building to continue to be occupied by Staff and Public alike.
- To demonstrate to the Public that Commonwealth Local Governments are actively working in partnership to make reasonable attempts to reduce their environmental impact.

As a result of the project, a significant reduction in energy consumption has been experienced across the site. From the data obtained to date, we estimate a total energy saving of 5.1% will be experienced with the added benefits of vastly increased reliability and redundancy in the system.
Appendix A – Baseline Energy Efficiency Improvement Summary
### Project Energy Efficiency Improvement Template

**PROJECT TITLE**: Civic Centre - New Chiller Installation  
**PROJECT ID**: CEEP 2153  
**FUNDING RECIPIENT**: Alice Springs Town Council  
**DATE**: 25/07/2013

#### Building, Facility or Site 1

<table>
<thead>
<tr>
<th>Name of Building, Facility or Site 1</th>
<th>Alice Springs Civic Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location (address)</td>
<td>Alice Springs Town Council - 93 Todd St, Alice Springs</td>
</tr>
<tr>
<td>Type of building, facility or site</td>
<td>Civic Centre, Administration, Community Spaces</td>
</tr>
<tr>
<td>Activity Type and Measure</td>
<td>Installation of New Chiller and associated reticulation and controls</td>
</tr>
<tr>
<td>Energy Efficiency Estimate Method</td>
<td>Desktop spread-sheet based simulation using nominated plant energy consumption, operating hours of facility and assumptions in line with original grant application - sourced from actual measured energy data</td>
</tr>
<tr>
<td>Baseline Energy Usage</td>
<td>4271.00kWh per annum + 1,539MJ of electricity and 481MJ of natural gas - total 2,019MJ (actual existing data from Alice Solar City)</td>
</tr>
<tr>
<td>Baseline Energy Efficiency</td>
<td>741MJ per m2 annum</td>
</tr>
<tr>
<td>Energy Efficiency Improvement</td>
<td>Reduction 48MJ per m2 annum</td>
</tr>
</tbody>
</table>
| Reporting Data (Measuring Energy Efficiency and Additional Data) | Total Conditioned Area of 2,725m2  
The building was refurbished and extended in 2004/205 |

#### Building, Facility or Site 2

| Name of Building, Facility or Site |  
| Location (address) |  
| Type of building, facility or site |  
| Activity Type and Measure |  
| Energy Efficiency Estimate Method |  
| Baseline Energy Usage |  
| Baseline Energy Efficiency |  
| Energy Efficiency Improvement |  
| Reporting Data (Measuring Energy Efficiency and Additional Data) |  
| Cost of Activity | $273,200 + GST |

**Estimated Cost Savings**: $10,600 at current electricity prices, a significant reduction in maintenance costs is also expected - in the order of $20,000 per annum based on present conservative maintenance costs.
the application is approved, the refusal of the application may be made by the Department. In the event of refusal, the Department will send a written notice to the applicant stating the reasons for the refusal.

The applicant may appeal the refusal to the Development Tribunal.

The Development Tribunal will consider the appeal and make a decision.

I, [Name of Applicant], declare that I am authorized to submit this application and that the information provided herein is true and correct.

[Signature]

Name: [Name]
Date: [Date]

DECLARATION

The applicant declares that all information provided is true and correct.