The Potential to Re-use Coal Combustion Products (CCPs) at Eraring Power Station in NSW, Australia

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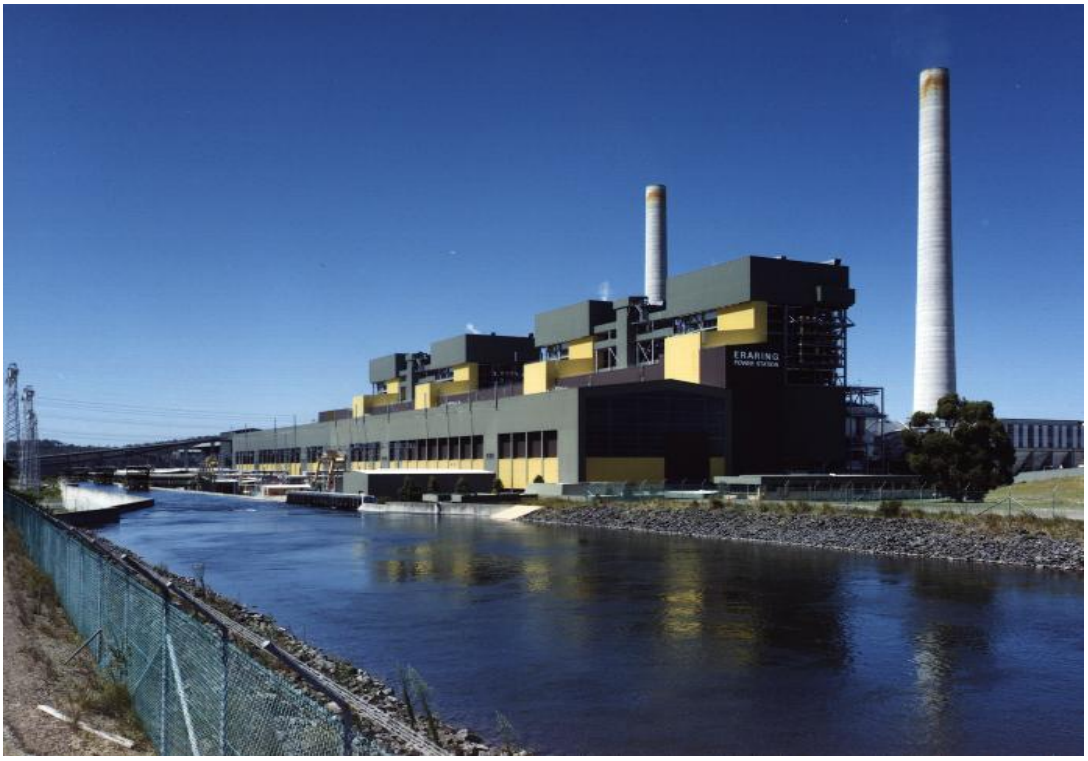
INTRODUCTION

Eraring Energy owns and operates a large coal fired power station just north of Sydney on the Central Coast of NSW, Australia known as Eraring Power Station (EPS) (see photograph 1). The power station was originally a 4 X 660 MW power station but is currently undergoing an upgrade that will see the output increased to 4 X 720 MW. The first upgraded unit was completed in 2010 and the second unit should be commissioned in April 2011. All units will be upgraded by the end of 2012.



Photograph 1 – Eraring Power Station

The average ash content for coal burnt in EPS is between 20% and 25% with EPS producing more than 1.5 million tonnes of CCP per year. Eraring Energy has in place contracts for the re-use of CCP including: -

- A contract with a third party for the re-use of more than 400,000 tonnes per year of fly ash in the cement and concrete industries. In late 2010, re-use through this contract passed 8 million tonnes (see attached photograph 2).

Photograph 2 – Fly ash processing plant

- A contract for the re-use of furnace bottom ash in various markets. Current re-use in this area is more than the power station produces such that mining of storage of deposits is occurring. Total sold to date - over 1,150,000 tonnes of furnace bottom ash (see attached photograph 3).

Photograph 3 – Dredge and screening equipment for furnace bottom ash recovery

NEW CCP PLANT

In 2009/10 Eraring Energy undertook an upgrade of the CCP handling plant at EPS as part of the overall upgrade of the power station output (see photograph 4) at a cost of $65M AUD.

Photograph 4 – New CCP plant at EPS

This upgrade included: -

- New CCP collection facilities on each unit,
- As part of the new collection facilities, new facilities that allowed segregation of “fine” fly ash used in the cement and concrete industries and “coarse” fly ash not wanted by those industries were installed,
- New pneumatic transport facilities to move the fly ash around the site and to the third party processing the fly ash for the cement and concrete industries,
- New storage facilities for the coarser dry fly ash fraction,
- These storage facilities included the installation of a dry fly ash loading facility and a “conditioned” (or slightly wetted) fly ash loading facility,
- New mixing and pumping facilities to place CCPs into the fly ash storage facility and
- New CCP placement techniques at the storage facility.

Prior to this work being undertaken the fly ash produced during the production of electricity was collected in the on site fabric filters. Fly ash collected during the fabric filter cleaning cycle (the finer fraction) was collected dry by a third party and pneumatically transported to their on site processing plant. The fly ash not required by the third party was directed to a sluice system which them was directed to a pumping system which placed “lean phase” slurry (lots of water and a small quantity of fly ash) into the CCP storage facility.

Over time the storage facility filled. In 2005, Eraring commenced reviewing the options for fly ash placement beyond the filling of the storage facility which at normal production rates was expected to be full by 2012. Options included: -

- Increasing the height of the wall of the existing storage facility – very expensive and difficult to achieve,
- Building a new storage facility nearby – unlikely to be approved and very unpopular with locals or
- Change the way that CCPs were placed in the storage facility – use “dense phase placement” rather than lean phase placement.

It was the third of these options – dense phase placement - that was chosen for the future placement and storage of CCP at EPS. The advantage of dense phase placement is that more fly ash can be positioned in the same area (approximately 40% more). There were some issues that needed to be overcome before this process could be utilised. This type of placement requires the use of gravity to allow the best results. Eraring Energy owned some land up towards a ridge line on the northern side of the storage facility but it was agreed that Eraring Energy should review the option of purchasing the land up to the top of the ridge line. This was Crown Land (Government owned).

Eraring Energy sought to purchase this land and ran into some issues as the sale process progressed. The first issue was a land claim by a local aboriginal land council. This was state issue and was overcome over time and the land claim was dismissed. However, there was Federal Native Title issue that was also needed to be overcome. This was a more difficult issue but was also overcome and found not to be applicable to the project area. This allowed Eraring Energy to finalise the purchase of the land needed to allow the dense phase project to be further developed.

The next stage was to get approval for the project from the state government. It sounded a simple procedure but was far from simple in execution. Eraring Energy ran into issues with “Threatened Species” and the local community when it was found that a reasonably large area of the storage facility was to be cleared of native vegetation to allow CCP to be placed. The state planning authority (Department of Planning) granted Eraring Energy only approximately half of the land up the rise to the ridgeline to be used for fly ash placement with the project approval. Additionally, compensatory habitat was required to be provided before clearing and fly ash placement could commence.

A defined Habitat Offset Plan was developed where 2 hectares of land similar in flora biodiversity was to be offered and protected for every 1 hectare to be cleared to a maximum of 21 hectares of clearing. Clearing was also to be staged with the maximum clearing in any one stage being 7 hectares. Prior to each clearing seed collection and propagation was to be carried out as well as translocation of the threatened species (tetratheca juncea or black eyed Susan – see photograph 5). With agreement reached on all these requirements Eraring Energy received project approval in April 2008.

Photograph 5 – Tetratheca Juncea (Black eyed Susan) – threatened species

Photograph 6 – Clearing at CCP storage facility

Eraring Energy was also required to meet a stipulated goal of re-using 80% of CCP produced at EPS by the end of 2015 as part of the project approval. At 1,500,000 tonnes per annum CCP production, Eraring is required to reuse 1,200,000 tonnes of CCP per year. This is an enormous ask as current reuse of CCPs is in the order of just over 500,000 tonnes per year.

In parallel with the project application Eraring Energy had been progressing the design of the new plant and the tender process had resulted in an order being placed with Clyde Bergemann Senior Thermal (CBST) in December 2007. Works began in July 2008 following the project approval and were completed in April 2010 with: -

- The storage and pumping system completed by December 2009,
- The first unit collection plant, Unit 1 was completed on line in December 2009,
- Unit 4 was connected during a planned unit shutdown and commissioned in December 2009,
- Unit 3 was connected on line and completed by February 2010,
- Unit 2 was connected on line and completed by February 2010,
- Fully commissioned in April 2010.

CCP PLANT DESIGN

The plant design was based on the premise that Eraring Energy would supply an improved quality of fly ash to the third party for use in the cement and concrete industries and allow Eraring Energy access to the dry fly ash for re-use prior to the placement of fly ash in the storage facility.

The improved quality of fly ash was accomplished by segregating the “fine” fly ash which is collected on the fabric filter bags during normal operation from the “coarse” fly ash which falls out of the air flow into the fabric filter hoppers. This resulted in the installation of small pressure vessels under each fabric filter hopper (40 per unit) and a level probe in each fabric filter hopper equivalent to the volume of the pressure vessel (see photographs 7 to 9).

Photographs 7, 8 and 9 – collection vessels on Units 1&2 and Unit 3 and Unit 4.

The pressure vessels operate in 8 rows each containing 5 vessels. In normal operation, whenever any level probe is covered by fly ash in any row then all 5 vessels in that row

are emptied (pneumatically transferred) to a “coarse” fly ash silo. All “coarse” fly ash ends up in the main storage silos where it can be accessed for reuse or pumped to the CCP storage facility.

When a fabric filter is cleaned (or shaken) to remove the “fine” fly ash collected on the fabric filter bag, the fly ash is stored in the hopper until all 5 fabric filters in that row have been shaken. This “fine” fly ash is then transferred to an intermediate “fine” fly ash silo (see photographs 10 and 11) before being pneumatically transferred to the third party for processing or if not required to the main storage silos.

Photograph 10 and 11 Intermediate silos Units 1&2 and Units 3&4

The number of “cycles” of filling and emptying of the pressure vessels is determined by the time between the cleaning cycles of the fabric filter bags in that row . The longer the period between the cleaning cycles of the fabric filter bags then the more “cycles” of filling and emptying is required as more fly ash has been collected on the fabric filter bags. This has resulted in an improved quality feedstock for the third party processing the fly ash for the cement and concrete industries.

The “coarse” fly ash not required by the third party plus the rejects from their processing plant (larger fraction or plus 45 micron in size) and any “fine” fly ash not utilised is stored in two 1,000 cubic metre storage silos. From here Eraring Energy can offer the fly ash for re-use through truck loading facilities for both dry fly ash for longer transport in road tankers (see photograph 12) or as “conditioned” (slightly wetted) fly ash for close transport in covered tip trucks (see photographs 13 and 14).

Photographs 12 (Dry fly ash loader) 13 and 14 (Conditioned fly ash loader)

It is the ability to access this dry fly ash that has allowed Eraring to offer the fly ash for other reuse projects. The outcome has been very favourable with many third parties now either committed to reusing Eraring fly ash or in discussions looking forward to formulate contracts for future reuse of Eraring fly ash. Recently Eraring commenced supplying dry fly ash for a major reuse project where fly ash is used as the major constituent in the back filling of old mine sites. It is intended then to build a new major freeway over these backfilled mine voids. This project (which is the first stage of the project) is for the reuse of 200,000 tonnes of fly ash over the next 12 to 18 months. A second stage is expected to commence sometime during stage one and it is anticipated to be of similar tonnage running concurrently with the first stage. Eraring is again in the front line for this work.

CCP not re-used is then mixed with recycled lake water used for the transfer of CCP to the storage facility and then pumped (see photograph 15) up to 3 kilometres to the storage facility using a dense phase slurry where it is placed over existing lean phase CCP deposits (see photograph 15). These deposits are available for recovery for re-use at a later time.

Photographs 15 (slurry pumps) and 16 (fly ash placement)

The new plant design required the installation of new air compressors to supply the air for the pneumatic transfer of the fly ash to the various plant areas (see photographs 17

and 18). Four new 1.1 MW air compressors were installed along with dryers and new cooling towers.

Photographs 17 (new air compressors) and 18 (pneumatic transfer vessels)

HAS THIS NEW CCP PLANT INCREASED RE-USE OF CCP FROM EPS?

The answer is positively yes. As indicated previously, Eraring Energy has recently signed two new contracts for the supply of CCP for major road projects: -

- The first is for more than 200,000 tonnes of dry fly ash which is to be used in a mine backfill project to allow extension of the major F3 freeway near Newcastle, NSW north of Sydney.
- The second is for up to 100,000 tonnes for work on a roadway near to Eraring Power Station.

There is great interest in the re-use of fly ash from Eraring Power Station in particular in tiles, bricks, mine back fill, geo-polymers etc. The above F3 project is likely to have a second stage of similar tonnage for which Eraring Energy is at the forefront to supply. An additional plus for Eraring Energy is the likely scenario that EPS will be at the forefront to supply cement grade fly ash for the F3 extension work as it is close to the power station site. Such re-use is assisting Eraring Energy to meet the stipulated goal of 80% re-use of CCP at EPS.

It is pleasing to see that the new facilities provided by Eraring Energy have increased the re-use of CCP from the EPS site and has allowed discussions to be carried out for further re-use options for CCP including longer term projects. The shorter term, project specific reuse options currently being supplied by Eraring Energy is a great step forward. It is longer term, consistent reuse of major tonnages of CCPs that are required to meet the goal set by Government. Eraring Energy is continuing to negotiate with third parties in an attempt to meet that stipulated goal.