NEWGEN POWER STATION KWINANA

GREENHOUSE GAS ABATEMENT PROGRAMME (GGAP)

December 2006

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1. Element/issue

Emission of greenhouse gases to the atmosphere as a result of the operation of the power station.

2. Objective

The objectives of this GGAP are:

(1) Through the use of best practice, to ensure that the total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product from the project are minimised; and

(2) To manage "greenhouse gas" emissions in accordance with the Framework Convention on Climate Change, 1992, and consistent with the National Greenhouse Strategy.

3. Current Status

Greenhouse gases such as carbon dioxide have been implicated in gradual global climatic changes. Greenhouse gases affect the balance between incoming solar energy and losses due to radiation from the earth and atmosphere. Pollutants of importance to greenhouse warming and associated with power generating activities are water vapour (H_2O), nitrous oxide (N_2O), carbon dioxide (CO_2) and methane (CH_4). Indirect greenhouse gases such as carbon monoxide (CO), nitrogen oxides other than N_2O and non-methane volatile organic compounds (NMVOCs) do not have a strong radiative forcing effect in themselves, but influence atmospheric concentrations of the direct greenhouse gases.

Water vapour is the major contributor to the greenhouse effect but is not normally considered in inventories because human output is negligible compared to the day-to-day precipitation cycle. Carbon dioxide is the next most significant greenhouse gas and the major anthropogenic contribution.

The NewGen Power Station is an emitter of carbon dioxide and to a much lesser extent, nitrous oxide and methane.

4. Potential emissions

The assessment of greenhouse gas emissions has been undertaken in accordance with the EPA's *Guidance for the Assessment of Environmental Factors, No 12, Minimising Greenhouse Gas Emissions*.

CO_2 will be produced during the operations of the NewGen Power Station and is also associated with transport of materials to and from the site. Emissions of greenhouse gases from the power station have been estimated to be initially 746,000 tonnes per year (CO_2 equivalent). With an average degradation factor of 0.3% per year, the total greenhouse gas emissions from the plant will be about 817,000 tonnes per year (CO_2 equivalent) in the 30th year of operation.

5. Program to minimise greenhouse gas emissions

NewGen Power will implement the following "no regrets measures[1]" that are consistent with the AGO's Generator Efficiency Standards to minimise greenhouse gas emissions:

- Minimise/reduce energy use through the following:
  - Installation of energy efficient lighting;
  - Installation of energy efficient air conditioning;
  - Routine monitoring of plant efficiency; and
  - Operate plant at optimum efficiency in accordance with manufacturer's operation and maintenance; and
- Implement a routine preventative maintenance and cleaning regime to maintain operation of the power station at optimal efficiency.
- Implement a "continuous improvement approach" so that advances in technology and potential operational improvements of plant performance are adopted where practicable.
- NewGen Power will become a member of the Greenhouse Challenge Plus Program.

NewGen Power will implement the following "beyond no regrets measures[2]" that are consistent with the AGO's Generator Efficiency Standards to minimise greenhouse gas emissions:

[1] "no regrets" measures are those which can be implemented by a proponent and which are effectively cost-neutral.

[2] "beyond no regrets" measures are those which can be implemented by a proponent and which involve additional costs that are not expected to be recovered.

- Annual auditing and reporting of greenhouse gas emissions; and
- Undertake a review every five years of state of the art mitigation measures to identify advances in technology and potential operational improvements of plant performance that are relevant for CCGT. Investigate the feasibility of implementing these technological or operational improvements at the NewGen Power Station.

The objective of the AGO's Generator Efficiency Standards is to have power plants move towards best practice efficiency by minimising the recoverable reductions from design/acceptance test efficiency (AGO 2001). Recoverable reductions are losses in efficiency that can be recovered by means of maintenance, repair, replacement, refurbishment of plant components or by correction of operational settings. Non-recoverable degradation in efficiency is casued by build up of scale and deposits, and by increased clearances, steam leakages etc, that cannot be recoverd except by major refurbishment.

NewGen Power is committed to minimising the recoverable reductions in accordance with the AGO's process flow chart illustrated in Figure 1. The process shown in Figure 1 ensures that the most appropriate energy efficiency options are evaluated and implemented during the appropriate phase of the plant's design and operation life cycle. For example, design options are assessed during the design phase and maintenance options during the operation phase.

6. Greenhouse gas efficiency

The AGO has published a guideline for the application of Generator Efficiency Standards, measured in terms of greenhouse intensity. This guideline includes the recommended practice for determining best practice greenhouse efficiency for existing and new fossil fuel based power plants (i.e. electricity generation plant or combined heat and power plant). For power stations and other combustion plant, the efficiency with which useful energy can be generated from fuel is an important indicator of the relative importance of a carbon dioxide source. One means of reducing carbon dioxide emissions is to increase the efficiency of fuel conversion or adopt technology that is more efficient at converting fuel into electricity.

Combined cycle gas turbines (CCGT) are the most greenhouse efficient fossil fuelled power generation technology currently available. CCGTs are widely used throughout the world as a response to abate greenhouse gas production from power generation. CCGT technology can achieve relatively low emissions of greenhouse gases because it utilises natural gas, a fuel that has the least carbon intensity of the fossil fuels and because it utilises the waste heat from the operation of the gas turbine to raise steam and generate additional electricity in a steam turbine.

Traditional steam cycles using natural gas fuel, while having similar thermal efficiencies to equivalent sized coal fired plant, have superior emissions performance due to the lower carbon intensity of the natural gas fuel when compared to coal.

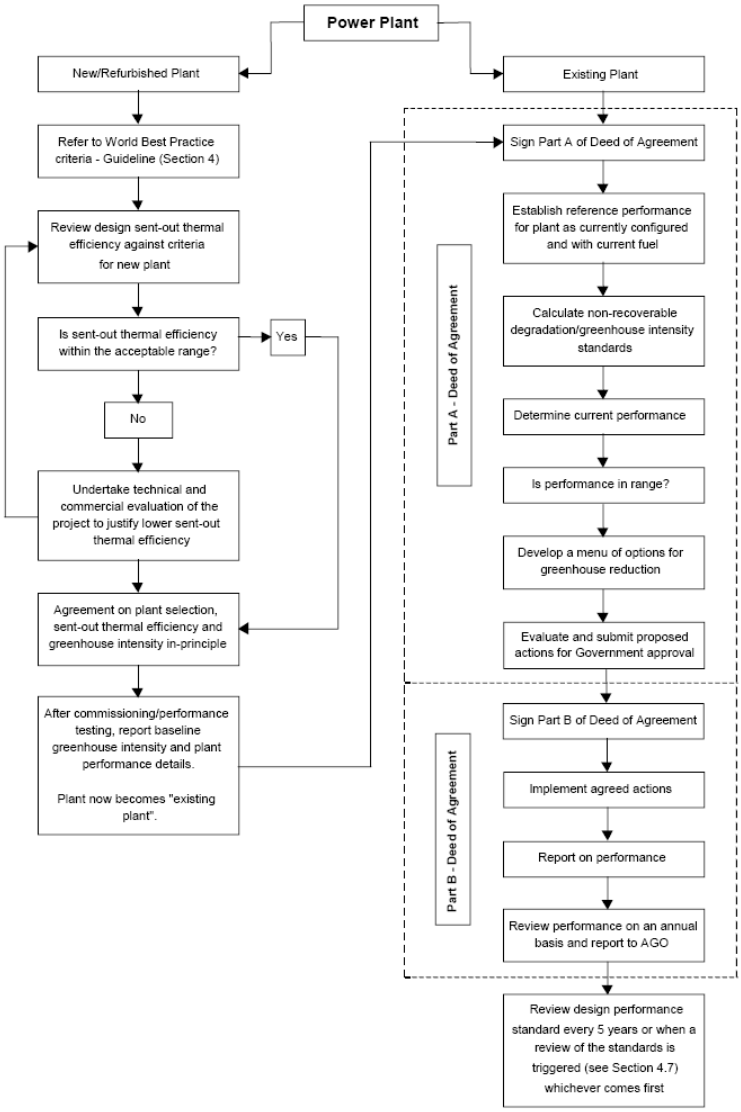

Figure 1 – Generator Efficiency Standards – Process flow chart

Figure 1 Generator Efficiency Standards Process Flow Chart (AGO 2001)

The NewGen Kwinana Gas-Fired Power Station is configured to deliver 320 MW of base load capability through the combination of a 240MW CCGT plant and an 80 MW conventional reheat steam cycle. The additional 80 MW steam cycle is achieved

through the addition of duct burners to direct fire natural gas into the heat recovery steam generator (HRSG), thus producing the effect of a conventional steam cycle.

The 240 MW high efficiency CCGT plant is designed to provide a thermal efficiency that is consistent with the best practice guidelines published by the AGO. The additional 80 MW of steam cycle is also designed to provide high efficiency output as it is generated through a high efficiency reheat cycle turbine as incremental load.

The AGO guidelines do not provide a specific target for either CCGT plant with duct firing or gas fired subcritical steam plant, however the AGO guidelines are based on a report by SKM (SKM 2000). A review of this report provides data on both Australian and world's best practice efficiencies for natural gas sub-critical steam plant. The efficiency of the NewGen Kwinana Gas-Fired Power Station is presented in Table 1 for each of the hybrid parts and as a whole and compared to the AGO guidelines.

Table 1: Efficiency of NewGen Kwinana Gas-Fired Power Station (%, Higher Heating Value (HHV) Basis)

Plant	Output MW	AGO efficiency standard at ISO conditions (HHV)	NewGen Kwinana expected efficiency at ISO conditions (HHV)
CCGT Plant	242.5	46.7%	48.1%
Steam Cycle (duct firing)	82	37.7%[1] (35.9%[2])	39.7%
Base load Hybrid Plant	324.5	[3]	46.0%

Notes:
[1] World's best Practice Natural Gas Steam cycle efficiency from SKM 2000
[2] Australian Best Practice Natural Gas Steam cycle efficiency from SKM 2000.
[3] There is no AGO efficiency standard for the hybrid plant; however, the plant efficiency may be calculated by weighted average output as 44.5% (44.0%) using the information published by SKM 2000 as shown for the steam cycle.

The predicted greenhouse gas intensity of the NewGen Power Station is compared in Table 2 with Western Power's average performance in 2005 and best practice levels that can be achieved with new technology or technology that is expected to be available in the near future.

Table 2: Comparison of predicted greenhouse gas intensity of NewGen Kwinana Gas-Fired Power Station with Western Power's average intensity in 2005 and best practice levels.

Source of emissions	Greenhouse gas intensity (tonnes CO_{2e}/MWh)
NewGen base load hybrid plant [1]	0.427
Western Power Corporation 2005 (including abatement actions)[2]	0.9
Best practice coal. Available near term.[3]	0.7-0.8
New open cycle natural gas with technology available now[3]	0.7
New natural gas (combined cycle)[3]	0.4

Note [1] Full fuel cycle
[2] Western Power 2005
[3] New South Wales Government 2004.

7. Greenhouse gas offsets

NewGen believes that greenhouse gas offsets are not required. As shown in Table 2, the NewGen Kwinana Gas-fired Power Station has a greenhouse intensity less than half of the current South West Interconnected Network. That is, energy generated from the NewGen power station has less than half the greenhouse emissions of the average for the network. Also, as shown in Table 1, the energy efficiency of the plant is better than best practice levels published by the Australian Greenhouse Office and will therefore have less emissions than that expected from a best practice similar power station.

The EPA's Bulletin 1190 states that:
…The EPA understands that the proposed CCGT combination represents the best practicable means of meeting the additional base-load power demand required by the SWIS. While the efficiency of the combination is less than a wholly CCGT plant, the EPA is satisfied that it represents best practice for base-load power generation in consideration of the new capacity requirements of the SWIS. CCGT plants are more thermally efficient than coal-fired plants and the EPA does not require offsets to approve this proposal. However, the EPA would encourage the proponent to consider carbon sink projects during the life of the project.

NewGen has considered greenhouse gas offsets and has determined that they will not be implemented at this time.

8. Monitoring and reporting

Greenhouse gas emissions will be monitored in accordance with the requirements of the Australian Greenhouse Office. In particular, the following information will be recorded and reported:

- Fuel types.
- Fuel usage (PJ for gas, tonnes for other fuels).
- Plant capacity (MW).
- Capacity factor (%).
- Output factor (%).
- MWh generated (monthly).
- MWh sent-out (monthly).
- MWh imported (monthly).
- Sent-out thermal efficiency (monthly).
- Average annual greenhouse intensity (kg $CO_{2\text{-}e}$/MWh) based on monthly averages.

An annual report will be prepared that summarises greenhouse gas emissions in accordance with the AGO's requirements specified in the Generator Efficiency Standards and the Greenhouse Challenge Plus programme.

9. Auditing

Annual audits will be conducted to assess compliance with this Greenhouse Gas Abatement Programme.

10. Review and revision

This Greenhouse Gas Abatement Programme will be reviewed at least every five years, as recommended by the AGO Generator Efficiency Standards, or when significant changes occur to regulatory requirements or the plant. As mentioned in Section 5, available technology for mitigating greenhouse gas emissions from CCGT will be reviewed every five years and adopted where practicable. As mentioned in Section 12, NewGen will become a member of the Commonwealth Government's Greenhouse Challenge Plus programme which will require an annual review of performance and reporting to the AGO.

11. Emission targets

The potential emissions provided in Section 4 are estimates based on 7,500 hours of operation in the year. Total emissions are not considered a good comparative indicator of greenhouse performance over time. Accordingly, emission targets have been set on a per unit of production basis.

Greenhouse gas emission targets for the NewGen Kwinana Gas-Fired Power Station are given in Table 3. The targets will be achieved through the implementation of the actions identified in Section 5 of this Greenhouse Gas Abatement Programme. Over a 30-year timeframe, the target reduction in greenhouse gas emissions is 0.78%.

It should be noted that the targets in Table 3 are design estimates. The actual greenhouse intensity of the NewGen Kwinana Power Station will be determined and reported every year and also compared with current best practice following the process and procedures specified in the AGO Generator Efficiency Standards that requires a review of best practice design performance standards every five years or when a review of the standard is triggered, whichever comes first. Actual plant performance and the extent of non-recoverable degradation can be determined. If required, options for improving actual performance will be identified, initiatives implemented and results reported as part of the Greenhouse Challenge Plus programme reports.

Table 3: Greenhouse gas emission targets.

End of Year	Approved (tCO_2e/MWhr)	Target GHG (tCO_2e/MWhr)	Target change (%)	End of Year	Approved (tCO_2e/MWhr)	Target GHG (tCO_2e/MWhr)	Target change (%)
1	0.426	0.427	0.30	16	0.446	0.442	-0.79
2	0.427	0.428	0.20	17	0.447	0.443	-0.84
3	0.429	0.429	0.10	18	0.448	0.444	-0.89
4	0.430	0.430	-0.20	19	0.450	0.446	-0.94
5	0.431	0.430	-0.25	20	0.451	0.447	-0.99
6	0.433	0.431	-0.30	21	0.453	0.448	-1.04
7	0.434	0.432	-0.35	22	0.454	0.449	-1.09
8	0.435	0.434	-0.40	23	0.455	0.450	-1.14
9	0.437	0.435	-0.45	24	0.457	0.451	-1.19
10	0.438	0.436	-0.50	25	0.458	0.452	-1.24
11	0.439	0.437	-0.55	26	0.459	0.453	-1.29
12	0.440	0.438	-0.60	27	0.461	0.455	-1.34
13	0.442	0.439	-0.65	28	0.462	0.456	-1.39
14	0.443	0.440	-0.70	29	0.463	0.457	-1.44
15	0.444	0.441	-0.75	30	0.465	0.458	-1.48

12. Greenhouse Challenge Plus

NewGen Power Station will become a member of the Commonwealth Government's Greenhouse Challenge Plus programme. A letter of intent will be forwarded to the Commonwealth Minister for Environment and Heritage as a first step toward becoming a member of the programme.

13. Greenhouse Gas Abatement Programme availability

The Greenhouse Gas Abatement Programme will be made publicly available by the following means:

- Free copies of the GGAP, when approved by the DEC for release, will be provided to – the DEC library (2 copies), Town of Kwinana public library (2 copies), and JS Battye library (2 copies);
- The GGAP will be posted on the NewGen Power website www.newgenpower.com.au; and
- DEC will be requested to advertise the availability of the GGAP in the "West Australian" newspaper.

During the impact assessment phase comments were received from the following stakeholders:

- DoE/Minister for the Environment;
- EPA;
- City of Rockingham;
- Kwinana Progress Association/Conservation of Rockingham's Environment;
- ACF/Conservation Council WA;
- Kwinana Industry Association; and
- KABZ Community Group.

14. Compliance review

Table 4 is a summary of sections of this Greenhouse Gas Abatement Programme referenced to the Minister for the Environment's Statement 698.

Table 4: Compliance Review - Minister for the Environment Approval, 7 November 2005.

Condition number	Condition Text	GGAP Section
7-1	Prior to commencement of construction, the proponent shall develop a Greenhouse Gas Abatement Programme to:	
	• ensure that the plant is designed and operated in a manner which achieves reductions in "greenhouse gas" emissions as far as practicable	2, 5, 6, 9, 10, 11, 12
	• provide for ongoing "greenhouse gas" emissions reductions over time;	5, 11
	• ensure that through the use of best practice, the total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product from the project are minimised; and	2, 5, 6, 11
	• manage "greenhouse gas" emissions in accordance with the *Framework Convention on Climate Change 1992*, and consistent with the National Greenhouse Strategy	2
	to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority. This Programme shall include:	
7-1(1)	calculation of the "greenhouse gas" emissions associated with the proposal, as advised by the Environmental Protection Authority;	6, 8, 11
7-1(2)	specific measures to minimise the total net "greenhouse gas" emissions and/or the "greenhouse gas" emissions per unit of product associated with the proposal using a combination of "no regrets" and "beyond no regrets" measures;	5
7-1(3)	consideration of the implementation of "greenhouse gas" offset strategies;	8
7-1(4)	estimation of the "greenhouse gas" efficiency of the project (per unit of product and/or other agreed performance indicators) and comparison with the efficiencies of other comparable projects producing a similar product, both within Australia and overseas;	6
7-1(5)	implementation of thermal efficiency design and operating goals consistent with the Australian Greenhouse Office Technical Efficiency guidelines in design and operational management;	2, 5, 6, 8, 11, 12
7-1(6)	actions for the monitoring, regular auditing and annual reporting of "greenhouse gas" emissions and emission reduction strategies;	8, 9, 10, 11, 12
7-1(7)	a target set by the proponent for the progressive reduction of total net "greenhouse gas" emissions and/or "greenhouse gas" emissions per unit of product and as a percentage of total emissions over time, and annual reporting of progress made in achieving this target. Consideration should be given to the use of renewable energy sources such as solar, wind or hydro power;	11
7-1(8)	a program to achieve reduction in "greenhouse gas" emissions, consistent with the target referred to in (7) above;	5
7-1(9)	entry, whether on a project-specific basis, company-wide arrangement or within an industrial grouping, as appropriate, into the Commonwealth Government's "Greenhouse Challenge" voluntary cooperative agreement program;	12
7-1(10)	review of practices and available technology;	5, 10
7-1(11)	"Continuous improvement approach" so that advances in technology and potential operational improvements of plant performance are adopted.	5, 10

15. References

Australian Greenhouse Office 2001, Technical Guidelines: Generator Efficiency Standards.

Katestone Environmental 2005, Air Quality Impact Assessment for the Proposed NewGen Gas-Fired Power Station, Kwinana. Report from Katestone Environmental to ELP.

New South Wales Government (2004), Energy Directions Green Paper.

SKM 2000, Australian Greenhouse Office Integrating Consultancy - Efficiency Standards for Power Generation Report, Sinclair Knight Merz Pty. Ltd. January 2000.

Western Power (2005), Annual Report 2005, Western Power Corporation.

16. Acknowledgements

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