# APPENDIX A

# Geological investigations

**Table 1: Geological investigations at Thyspunt**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Regional and semi-regional geology. | Yes | A | 1:50k AEC map, to be updated, 5 days |
| Site vicinity and site specific geology, including palaeo-tsunami evidence, palaeo-earthquake and -liquefaction occurrences, tectonics, geophysics. | No | A | 1:50k AEC map, to be updated, 5 days |
| Data collection - existing geology coverages (digital), topographic and topocadastral information (digital), air photos (colour digital, if available), satellite imagery, hydroclimatic coverages, land-use and vegetation-type coverages. | Yes for available data | A | Hydroclimate, land-use and vegetation not part of CGS |
| Geographic Information System (GIS) compilation of coverages and base plans containing above information - required for site reconnaissance. | Yes for available data | A | |
| Remote Sensing interpretation to identify land facets, site aspects, quarries and cuttings, and other relevant surface features to familiarise oneself with the expected ground conditions. | No | | |
| Site reconnaissance: field inspection and documentation of relevant surface features, exposures (road cuttings, outcrops areas, accessibility, potential problem areas etc) as identified in RS & GIS-based desk -top surveys. | No | | |
| GIS-based mapping of soil and rock-type distributions around the (selected) sites. | No | | |
| Field structural mapping of outcrop-scale bed-rock fracturing. | No | | |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| GIS-compilation and interpretation of geological and structural data. | Yes | | |
| GIS-compilation and interpretation of geophysical data. | Yes | | |
| Identification of selected sites for pit sampling and trench-profiling | No | | |
| Logging of pits and trenches | No | | |
| GIS compilation and map integration of pit and trench data. | No | | |
| Look for strong motion effects in young sediments | No | | |
| Study the Swartkops Scarp | No | | |
| Seismic reflection survey over proposed strike of Cape St Francis fault | No | | |

**Table 2: Geological investigations at Bantamsklip**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Regional & semi-regional geology with emphasis on Quaternary period, including structural geology and tectonics, palaeoseismology, geophysics. | Yes | A | More work needed on prehistoric earthquakes |
| Site vicinity & specific geology structural geology and tectonics, palaeoseismology, geophysics, palaeo-tsunami evidence, palaeo-liquefaction occurrences. . | No | A | 200m line spacing mag was collected |
| Data collection - existing geology coverages (digital), topographic and topocadastral information (digital), air photos (colour digital, if available), satellite imagery, hydroclimatic coverages, land-use and vegetation-type coverages. | Yes for available data | A | Hydroclimate, land-use and vegetation not part of CGS |
| Geographic Information System (GIS) compilation of coverages and base plans containing above information - required for site reconnaissance. | Yes for available data | A | |
| Remote Sensing interpretation to identify land facets, site aspects, quarries and cuttings, and other relevant surface features to familiarise oneself with the expected ground conditions. | No | | |
| Site reconnaissance: field inspection and documentation of relevant surface features, exposures (road cuttings, outcrops areas, accessibility, potential problem areas etc) as identified in RS & GIS-based desk -top surveys. | No | | |
| GIS-based mapping of soil and rock-type distributions around the (selected) sites. | No | | |
| Field structural mapping of outcrop-scale bed-rock fracturing. | No | | |
| GIS-compilation and interpretation of geological and structural data. | Yes | | |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| | | | |
| GIS-compilation and interpretation of geophysical data. | Yes | A | Magnetic data only |
| Identification of selected sites for pit sampling and trench-profiling | No | | |
| Logging of pits and trenches | No | | |
| GIS compilation and map integration of pit and trench data. | No | | |

**Table 3: Geological investigations at Duynefontein (Koeberg)**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Regional and semi-regional geology. | Yes | A | Needs reviewing and updating |
| Site vicinity and site specific geology. | Yes | A | Needs review, add palaeo tsunami study |
| Data collection - existing geology coverages (digital), topographic and topocadastral information (digital), air photos (colour digital, if available), satellite imagery, hydroclimatic coverages, land-use and vegetation-type coverages. | Yes for available data | A | Hydroclimate, land-use and vegetation not part of CGS |
| Geographic Information System (GIS) compilation of coverages and base plans containing above information - required for site reconnaissance. | Yes for available data | A | Needs reviewing and updating |
| Remote Sensing interpretation to identify land facets, site aspects, quarries and cuttings, and other relevant surface features to familiarise oneself with the expected ground conditions. | Yes | A | Needs reviewing and updating |
| Site reconnaissance: field inspection and documentation of relevant surface features, exposures (road cuttings, outcrops areas, accessibility, potential problem areas etc) as identified in RS & GIS-based desk -top surveys. | Yes | A | Needs reviewing and updating |
| GIS-based mapping of soil and rock-type distributions around the (selected) sites. | Yes | A | Needs reviewing and updating |
| Field structural mapping of outcrop-scale bed-rock fracturing. | Yes | | Needs reviewing and updating |
| GIS-compilation and interpretation of geological and structural data. | Yes | | Needs reviewing and updating |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| GIS-compilation and interpretation of geophysical data. | Yes | | Needs reviewing and updating |
| Identification of selected sites for pit sampling and trench-profiling | No | | |
| Logging of pits and trenches | No | | |
| GIS compilation and map integration of pit and trench data. | No | | |

**Table 4. Geological investigations at Brazil and Schulpfontein**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Regional and semi regional geology. | Yes | A | |
| Site vicinity and site specific geology, including palaeo-tsunami evidence, palaeo-earthquake and -liquefaction occurrences, tectonics, geophysics. | No | | |
| High density airborne geophysical data collection | No | | |
| Data collection - existing geology coverages (digital), topographic and topocadastral information (digital), air photos (colour digital, if available), satellite imagery, hydroclimatic coverages, land-use and vegetation-type coverages. | Yes for available data | A | Hydroclimate, land-use and vegetation not part of CGS |
| Geographic Information System (GIS) compilation of coverages and base plans containing above information - required for site reconnaissance. | Yes for available data | A | |
| Remote Sensing interpretation to identify land facets, site aspects, quarries and cuttings, and other relevant surface features to familiarise oneself with the expected ground conditions. | No | | |
| Site reconnaissance: field inspection and documentation of relevant surface features, exposures (road cuttings, outcrops areas, accessibility, potential problem areas etc) as identified in RS & GIS-based desk -top surveys. | No | | |
| GIS-based mapping of soil and rock-type distributions around the (selected) sites. | No | | |
| Field structural mapping of outcrop-scale bed-rock fracturing. | No | | |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| GIS-compilation and interpretation of geological and structural data. | Yes | | |
| GIS-compilation and interpretation of geophysical data. | No | | |
| Identification of selected sites for pit sampling and trench-profiling | No | | |
| Logging of pits and trenches | No | | |
| GIS compilation and map integration of pit and trench data. | No | | |

# APPENDIX B
# Scope of work to determine mitigating measures to minimize the geological impact on the project.

**Scope of work that needs to be done at Thyspunt to determine mitigating measures to minimize the geological impact on the project.**

a) Review of geological data at NECSA.
b) Updating the 1:50 000 geological maps of the AEC
c) Mapping on 1: 2000 scale within the 8km radius and 1:1000 scale within the 1km radius of the site with respect to geology, tectonics, etc.
d) Further investigation of the Cape St Francis fault. Possibly reflection seismics.
e) Study the Swartkops Scarp.

f) Determination through expert consensus which palaeoseismic investigations can be done on the Plettenberg fault to decrease the uncertainties about its activity during the Quaternary.
g) Remote Sensing interpretation to identify land facets, site aspects, quarries and cuttings, and other relevant surface features within the 8 km and 1 km radii.
h) Site reconnaissance map and documentation of relevant surface features, exposures (road cuttings, outcrops areas, accessibility, potential problem areas etc) as identified in RS & GIS-based desk -top surveys.
i) GIS-based mapping of soil and rock-type distributions around the (selected) sites.
j) Field structural mapping of outcrop-scale bed-rock fracturing.
k) Identification of selected sites for pit sampling and trench-profiling.
l) Logging of pits and trenches.
m) GIS compilation and map integration of pit and trench data.

**Scope of work that needs to be done at Bantamsklip to determine mitigating measures to minimize the geological impact on the project.**

a) Follow-up, interpretation and conclusion of evidence for neotectonics near Bantamsklip as reported in Andreoli et al. (1994) and De Beer (2005).
b) Updating the 1:50 000 geological maps of the AEC and 1: 2000 mapping of the sites within the 8 km radius and 1:1000 mapping within the 1km radius of the site with respect to geology, tectonics.
c) Remote Sensing interpretation to identify land facets, site aspects, quarries and cuttings, and other relevant surface features to familiarise oneself with the expected ground conditions.
d) Site reconnaissance map and documentation of relevant surface features, exposures (road cuttings, outcrops areas, accessibility, potential problem areas etc) as identified in RS & GIS-based desk-top surveys.
e) GIS-based mapping of soil and rock-type distributions around the (selected) sites.
f) Field structural mapping of outcrop-scale bed-rock fracturing.
g) Field structural mapping of outcrop-scale bed-rock fracturing.
h) Identification of selected sites for pit sampling and trench-profiling.
i) Logging of pits and trenches for signs of prehistoric strong ground motion.
i) GIS compilation and map integration of pit and trench data.

**Scope of work that needs to be done at Brazil and Schulpfontein to determine mitigating measures to minimize the geological impact on the project.**

a) Follow-up of and interpretation of evidence for neotectonic activity as reported in De Beer (2006a and b).

b) Collecting high density magnetic and radiometric data.
c) Collecting high resolution offshore multibeam and side-scan data.
d) Determining through expert consensus how to decrease the uncertainties associated with the offshore Kleinsee and Hondeklip Bay faults.
e) Updating the 1:100 000 scale geological maps of NECSA and 1: 2000 mapping of the sites within the 8km radius and 1:1000 mapping within the 1km radius of the site with respect to geology, tectonics.
f) Remote Sensing interpretation to identify land facets, site aspects, quarries and cuttings, and other relevant surface features to familiarise oneself with the expected ground conditions.
g) Site reconnaissance map and documentation of relevant surface features, exposures (road cuttings, outcrops areas, accessibility, potential problem areas etc) as identified in RS & GIS-based desk -top surveys.
h) GIS-based mapping of soil and rock-type distributions around the (selected) sites.
i) Field structural mapping of outcrop-scale bed-rock fracturing.
j) GIS-compilation and interpretation of geophysical data.
k) Identification of selected sites for pit sampling and trench-profiling
l) Logging of pits and trenches for signs of prehistoric strong ground motions and faulting.
m) GIS compilation and map integration of pit and trench data.

**Scope of work that needs to be done at Koeberg to determine mitigating measures to minimize the geological impact on the project.**

a) Review and update all the available geological data and maps in possession of Eskom and the existing 1:50 000 geological maps of the CGS for this area. Perform 1: 2000 scale geological and structural mapping within the 8km radius and 1:1000 mapping within the 1km radius around the site.. Focus on the Quaternary geology and tectonics.
b) Resolve the existing problems surrounding the so called " Milnerton fault" and reduce the uncertainty as to the source of the 1809-1810 seismicity .
c) Identification of selected sites for pit sampling and trench-profiling to try determine the recurrence intervals of large seismic events in this area.
d) Logging of named pits and trenches.
e) GIS compilation and map integration of pit and trench data.

# APPENDIX C

# Seismological investigations

**Table 5. Seismological investigations for Thyspunt**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Updating and standardization of regional earthquake catalogues according to modem international conventions of format and earthquake-size (magnitude / seismic moment) homogeneity. | Yes | A | |
| Re-assessment of earthquake frequency-size distributions and statistics. | Yes | A | |
| Re-determination of "maximum regional magnitude/moment" in tapered Pareto formulation. | No | | |
| Selection of appropriate "scenario earthquake" parameters (epicentre latitude and longitude hypocentre depth, moment magnitude, seismic-attenuation formulae) from historical and instrumental catalogue records (e.g. the 1809 Milnerton earthquake scenario for the Koeberg location). | Yes | | |
| Quantitative loss-estimation modelling for selected scenario earthquakes (using RADIUS, QuakeLoss, ShakeMap, and/or other suitable software) | No | | Not CGS function |
| Palaeoseismic investigations (selected trench-profiling) for identification of possible great prehistoric earthquakes and determination of site susceptibility to liquefaction during severe ground shaking. | No | | Only one trench along Cango fault in the Baviaanskloof done. |
| Review of far-field, trans-Indian Ocean impact predictions from numerical modeling of the next (imminent?) Great Sumatran earthquake tsunami (1797/1833 Mentawai source zone), with special reference to the Thyspunt, Bantamsklip and Koeberg sites. | Partially | | Formalise, Write-up |
| Review of far-field-impact predictions from numerical modeling of a trans-Atlantic ocean (South Sandwich Trench earthquake/tsunami source, with special reference to the | Partially | | Formalise, write-up |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Koeberg and Northern Cape sites. | | | |
| Review of coastal-zone geomorphology, sedimentology, onland and offshore (continental slope) Quaternary stratigraphy, for palaeo-tsunami indicators from either Atlantic or Indian trans-oceanic sources and for local tsunami sources due to (earthquake-triggered?) submarine slump/slide activity on the continental margin of the Cape Basin (as actually recorded along the Table_Bav shoreline immediately following the M6+ event historical event on 4 December 1809). | No | | |

**Table 6. Seismological investigations for Bantamsklip**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Updating and standardization of regional earthquake catalogues according to modem international conventions of format and earthquake-size (magnitude / seismic moment) homogeneity. | Yes | | |
| Re-assessment of earthquake frequency-size distributions and statistics. | Yes | | |
| Re-determination of "maximum regional magnitude/moment" in tapered Pareto formulation. | No | | |
| Selection of appropriate "scenario earthquake" parameters (epicentre latitude and longitude hypocentre depth, moment magnitude, seismic-attenuation formulae) from historical and instrumental catalogue records (e.g. the 1809 Milnerton earthquake scenario for the Koeberg location). | Yes | | |
| Quantitative loss-estimation modeling for selected scenario earthquakes (using RADIUS, QuakeLoss, ShakeMap, and/or other suitable software) | | | Not CGS function |
| Palaeoseismic investigations (selected trench-profiling) for identification of possible great prehistoric earthquakes and determination of site susceptibility to liquefaction during severe ground shaking. | No | | |
| Review of far-field, trans-Indian Ocean impact predictions from numerical modeling of the next (imminent?) Great Sumatran earthquake tsunami (1797/1833 Mentawai source zone), with special reference to the Thyspunt, Bantamsklip and Koeberg sites. | Partially | | Formalise, write-up |
| Review of far-field-impact predictions from numerical modelling of a trans-Atlantic ocean (South Sandwich Trench earthquake/tsunami source, with special reference to the | Partially | | Formalise, write-up |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Koeberg and Northern Cape sites.<br>Review of coastal-zone geomorphology, sedimentology, onland and offshore (continental slope) Quaternary stratigraphy, for palaeo-tsunami indicators from either Atlantic or Indian trans-oceanic sources and for local tsunami sources due to (earthquake-triggered?) submarine slump/slide activity on the continental margin of the Cape Basin (as actually recorded along the Table Bav shoreline immediately following the M6+ event historical event on 4 December 1809). | | | |

**Table 7. Seismological investigations for Koeberg**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Updating and standardization of regional earthquake catalogues according to modem international conventions of format and earthquake-size (magnitude / seismic moment) homogeneity. | Yes | | |
| Re-assessment of earthquake frequency-size distributions and statistics. | Yes | | |
| Re-determination of "maximum regional magnitude/moment" in tapered Pareto formulation. | No | | Not CGS |
| Selection of appropriate "scenario earthquake" parameters (epicentre latitude and longitude hypocentre depth, moment magnitude, seismic-attenuation formulae) from historical and instrumental catalogue records (e.g. the 1809 Milnerton earthquake scenario for the Koeberg location). | Yes | | |
| Quantitative loss-estimation modelling for selected scenario earthquakes (using RADIUS, QuakeLoss, ShakeMap, and/or other suitable software) | | | Not CGS function |
| Palaeoseismic investigations (selected trench-profiling) for identification of possible great prehistoric earthquakes and determination of site susceptibility to liquefaction during severe ground shaking. | No | | |
| Review of far-field, trans-Indian Ocean impact predictions from numerical modeling of the next (imminent?) Great Sumatran earthquake tsunami (1797/1833 Mentawai source zone), with special reference to the Thyspunt, Bantamsklip and Koeberg sites. | Partially | | Formalise, write-up |
| Review of far-field-impact predictions from numerical modeling of a trans-Atlantic ocean (South Sandwich Trench earthquake/tsunami source, with special reference to the | Partially | | Formalise, write-up |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Koeberg and Northern Cape sites. | | | |
| Review of coastal-zone geomorphology, sedimentology, onland and offshore (continental slope) Quaternary stratigraphy, for palaeo-tsunami indicators from either Atlantic or Indian trans-oceanic sources and for local tsunami sources due to (earthquake-triggered?) submarine slump/slide activity on the continental margin of the Cape Basin (as actually recorded along the Table_Bav shoreline immediately following the M6+ event historical event on 4 December 1809). | No | | |

**Table 8. Seismological investigations for Brazil and Schulpfontein**

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Updating and standardization of regional earthquake catalogues according to modem international conventions of format and earthquake-size (magnitude / seismic moment) homogeneity. | Yes | | |
| Re-assessment of earthquake frequency-size distributions and statistics. | Yes | | |
| Re-determination of "maximum regional magnitude/moment" in tapered Pareto formulation. | No | | |
| Selection of appropriate "scenario earthquake" parameters (epicentre latitude and longitude hypocentre depth, moment magnitude, seismic-attenuation formulae) from historical and instrumental catalogue records (e.g. the 1809 Milnerton earthquake scenario for the Koeberg location). | Yes | | |
| Quantitative loss-estimation modelling for selected scenario earthquakes (using RADIUS, QuakeLoss, ShakeMap, and/or other suitable software) | | | Not CGS function |
| Palaeoseismic investigations (selected trench-profiling) for identification of possible great prehistoric earthquakes and determination of site susceptibility to liquefaction during severe ground shaking. | No | | |
| Review of far-field, trans-Indian Ocean impact predictions from numerical modelling of the next (imminent?) Great Sumatran earthquake tsunami (1797/1833 Mentawai source zone), with special reference to the Thyspunt, Bantamsklip and Koeberg sites. | Partially | | Formalise, write-up |
| Review of far-field-impact predictions from numerical modelling of a trans-Atlantic ocean (South Sandwich Trench earthquake/tsunami source, with special reference to the | Partially | | Formalise, write-up |

| Task | Completed | Quality | Comments |
|---|---|---|---|
| Koeberg and Northern Cape sites. | | | |
| Review of coastal-zone geomorphology, sedimentology, onland and offshore (continental slope) Quaternary stratigraphy, for palaeo-tsunami indicators from either Atlantic or Indian trans-oceanic sources and for local tsunami sources due to (earthquake-triggered?) submarine slump/slide activity on the continental margin of the Cape Basin (as actually recorded along the Table_Bav shoreline immediately following the M6+ event historical event on 4 December 1809). | No | | |

# APPENDIX D

## Scope of work that needs to be done at sites to determine mitigating measures to minimize the seismological impact on the project.

**Scope of work that needs to be done at Thyspunt to determine mitigating measures to minimize the seismological impact on the project.**

a) Update the seismological catalogue for site.
b) Add additional palaeoseismic events to catalogue.
c) Determine new PSHA.
d) Determine PSHA by Logic Tree (EPRISOG) technique.
e) Describe the uncertainties surrounding (a) to (d) above.

**Scope of work that needs to be done at Bantamsklip to determine mitigating measures to minimize the seismological impact on the project.**

a) Update the seismological catalogue for site.
b) Add additional palaeoseismic events to catalogue.
c) Determine new PSHA.
d) Determine PSHA by EPRISOG technique.
e) Describe the uncertainties surrounding (a) to (d) above.

**Scope of work that needs to be done at Duynefontein to determine mitigating measures to minimize the seismological impact on the project.**

a) Update the seismological catalogue for site.
b) Add additional palaeoseismic events to catalogue.
c) Determine new PSHA.
d) Determine PSHA by EPRISOG technique.
e) Describe the uncertainties surrounding (a) to (d) above.

**Scope of work that needs to be done at Brazil and Schulpfontein to determine mitigating measures to minimize the seismological impact on the project.**

a) Update the seismological catalogue for site.
b) Add additional palaeoseismic events to catalogue.
c) Determine new PSHA.
d) Determine PSHA by EPRISOG technique.
e) Describe the uncertainties surrounding (a) to (d) above.