APPENDIX L

NOISE ASSESSMENT STUDY
BRANDON GENERATING STATION

Prepared for:

MANITOBA HYDRO
820 Taylor Avenue
Winnipeg, Manitoba R3C 2P4

Prepared by:

SENES Consultants Limited
121 Granton Drive, Unit 12
Richmond Hill, Ontario L4B 3N4

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1.0 INTRODUCTION

1.1 BACKGROUND

SENES Consultants Limited (SENES) was retained by Manitoba Hydro to conduct both a background noise monitoring program, as well as a predictive noise modelling study of various on-site noise sources, for the Brandon Generating Station (BGS) in Brandon, Manitoba.

This report presents the results of the noise modelling conducted for the BGS based on the spot noise measurement data collected at various on-site noise sources by SENES. This report assesses the noise impact of the Brandon plant during start-up mode, as well as during regular steady operation mode.

1.2 REPORT FORMAT

In addition to this introductory chapter, Chapter 2 describes the existing operations at the plant as well as on-site noise sources during start-up and regular steady operation. Chapter 3 provides a brief review of the applicable regulations/guidelines. Chapter 4 presents the spot measurement data collected at the Brandon plant, at various noise sources and during different operational modes. Chapter 5 discusses the model used and the results obtained from the modelling exercise. Chapter 6 outlines the key conclusions. The background noise study results are presented in Attachment A to this report.

2.0 EXISTING CONDITIONS

2.1 STATION LOCATION

Manitoba Hydro's Brandon Generating Station (BGS) is located in the City of Brandon, Manitoba. The BGS stands on the south bank of the Assiniboine River on the east side of the City of Brandon, which is located about 200-km west of the City of Winnipeg. The station is one of two thermal generating stations (the other being Selkirk) that provide support to the predominantly hydroelectric system.

The area to the north of the station is dominated by agricultural land use. Victoria Street runs east-west, immediately south of the Station. South of Victoria Street there is an active landfill. An aggregate/gravel crushing/screening facility and a wastewater treatment plant operates to the east and southeast of the Station. A relatively large fertilizer facility operates to the far southwest of the facility. Manitoba Hydro's Cornwallis office building and a second switchyard are located about 500m west of the Station. About 1.6 km west of the Station, there are residences, along 17th Street (see Figure 2.1)

2.2 STATION OPERATIONS AND PROCESS DESCRIPTION

The initial Station, consisting of four coal-fired boilers and four steam turbines, went into service in 1958, with a total capacity of 132 MW (33 MW each). During the 1970's a fifth coal-fired boiler and turbine (Unit #5) was added to boost the capacity by 105 MW. The initial four Units were laid-up in 1995 - 1996. The fuel for Unit #5 is sub-bituminous coal, brought to the Station by train (2 trains per week). The rail cars are unloaded and the coal is stockpiled on-site. Coal is crushed and transported to in-Station storage silos before being pulverized and burned in the boiler. The boiler is initially lit-off utilizing fuel oil and transfers to coal firing as the boiler comes up to temperature.

In the summer of 2002, two single-cycle combustion turbines, each with a nominal capacity of 130 MW, were constructed at the BGS. The major generating components of the gas turbines, including compressor, combustor, high pressure turbine and the generator, are enclosed in a newly erected building, southwest of the original generating building. The exhaust gases from the combustion turbines are discharged through two 30-metre high stacks (one per turbine). The building itself is a steel-framed structure clad with a pre-finished insulated metal wall system. The turbine components are enclosed in an acoustical enclosure to mitigate noise.

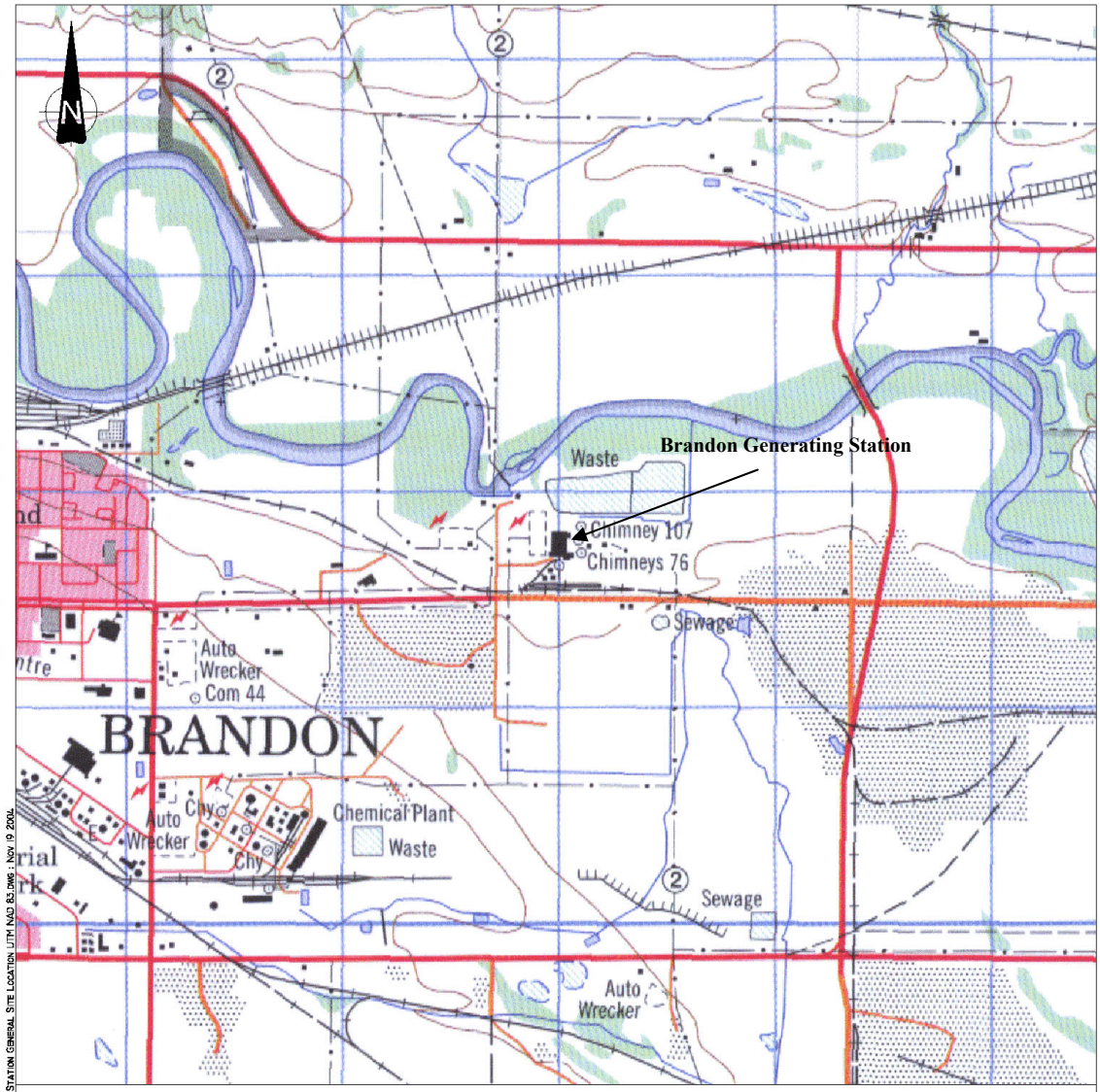


FIGURE 2.1

GENERAL SITE LOCATION
BRANDON GENERATING STATION

ADD No. 0 ADD No. ADD No. ADD No. metres

2.3 ON-SITE NOISE SOURCES

The general noise sources at Brandon Generating Station include:

- *Transformers:* There are a total of 12 transformers. Three Unit transformers, three generator transformers and two station service transformers are located adjacent to the east wall of turbine hall building, enclosing Unit #5 and the laid-up Units #1 to #4. There are also two generator transformers and two service transformers located west of the combustion turbine building (see Figure 4.1). The noise emitted from the transformers is a low frequency, mono-tonal type, which tends to travel long distances. When the Station is not operating and other activities such as coal car unloading and coal crushing are not occurring at the site, the transformers are the dominant noises source at the facility, as they are usually energized. Nevertheless, the noise emitted from transformers is not audible at any of the receptor locations.

- *Switchyard:* The switchyard is located to the east of the turbine hall building, east of transformers (see Figure 4.1). Under normal operating conditions, the noise emitted from the switchyard is inaudible, even in its close vicinity.

- *Steam Turbine Building:* The noise sources inside the turbine hall include Unit #5 steam turbine & generator, pumps, fans and vents. The building has numerous large doorways that open to the east and north. When closed, the noise from the operating noise sources inside the building is only audible in close vicinity to the building. To the east, with the doors closed, the dominant noise sources outside of the building are the transformers.

- *Boiler Building:* The noise sources inside the boiler building include four coal pulverizer Units, blow-down tank with muffler and rooftop vent, boiler, I.D. fans, F.D. fans, P.A. fans, Station air compressors, pumps, fans and vents. During the Station start-up mode, the dominant noise sources inside the building are the blow-down tank and the steam exhaust muffler, and outside the building, the steam vent. When preparing for turbine roll-off, the steam generated is initially released into the blow-down tank, which exhausts through a muffler and vents through a rooftop vent. The noise associated with each of the three noise sources is directly proportional with the steam pressure, which may get as high as 9 Mega Pascal (MPa). When in operation, the noise from the boiler, coal pulverizers, pumps and fans are the dominant noise sources inside the building, with pulverizers and Station air compressor being the chief sources on the main floor and the boiler on the higher floors. During start-up, the steam from the blow-down tank passes through the muffler and vents through a rooftop vent.

- *Dust Collectors:* There are three dust collectors at the facility: one at the coal car unloading building, one at the coal crusher building and one on the rooftop of the boiler building, servicing the coal silos inside the boiler building. Each dust collector operates only during unloading of rail cars, crushing of coal and loading of silos. There are two distinct noise sources associated with each dust collector, namely the continuous noise from the main fan and the cyclic noise from the automatic cleaner system. The dust collectors for the coal car unloading building and coal crusher building are located outside of the building and thus, when doors and overhead bay doors to the buildings are closed, the dust collectors are the dominant noise sources outside the buildings (specially to the north of the coal unloading building). The dust collector that serves the coal silos inside the main building (boiler building) is not enclosed. This, and the fact that it is elevated (rooftop), makes the noise emitted from it audible at longer distances than the other two dust collectors. When in operation, the noise from the three dust collectors is inaudible at the receptor locations.

- *Conveyor Belts:* Enclosed conveyor belts are used to transport coal from the unloading building to the crusher building, and from the crusher building to the boiler building and stockpiles. The conveyor belts are all enclosed and the noise associated with them is mainly due to vibration of side cladding and the driver motors. The noise from the conveyors is inaudible above the noises from the dust collectors.

- *Cooling Towers:* A five-cell cooling tower is located to the east of the main building. The noise from the cooling tower emanates from the rooftop fans and the water flow over the plates on the sides of the cooling tower. The noise from both of these sources is localized and thus not even audible from the rooftop of the main building about 100 m away. Each of the gas turbines has a four-cell dry cooling tower, located west of the combustion turbine building. The noise associated with these dry cooling towers is audible only in their immediate vicinity and is not audible at the closest fenceline (i.e., eastern fence line).

- *Natural Gas (NG) Pressure Reducer Building:* Natural gas enters the Station at high pressure, and must go through a pressure reduction step prior to being used in the gas combustion turbines. The pressure reducer building is located to the north of the combustion turbine building, north of the entrance roadway. The pressure reducer is enclosed in a metal cladding, one-story building, with one opening to the south. The noise associated with this source is directly proportional to the power output of the combustion turbines (higher gas flow is required for higher power output). The noise from this source is not audible at the closest property boundary.

- *Natural Gas Conditioner:* After going through the pressure reducer, the temperature of the natural gas drops significantly. Before being fed to the gas turbine, the fuel gas is conditioned by raising its temperature to about 25°C. The gas is also passed through a knock out vessel for condensate removal. The fuel gas conditioner system is located outside of the combustion turbine building, immediately to the east of it. The noise from the knock-out vessel and the fuel gas heater fan is audible on the east side of the 33rd Street, but not at Manitoba Hydro's Cornwallis office building (500 m east of the Station), nor at the receptor locations on 17th Street.

- *Coal Unloading Building:* Coal is transported to the facility by rail. The coal cars are unloaded in a metal-clad unloading building, located at the south end of the property, about 50 m north of Victoria Street. The building has two overhead bay doors opening to the east and west for the cars to enter. During each unload operation, one coal car is placed inside the building with the bottom hatches aligned with the underground hopper. Two coal car shakers, each consisting of a metal frame and an electric motor turning an off-centred weight, are placed on top of the coal car (one at each end) to help with the unloading of the cars. The shakers operate for about 40 – 60 seconds each time. The noise associated with the unloading operation (i.e., when shakers are operating) is significant, especially with the overhead bay doors open. Normally, during the unloading operation, both the east and west overhead doors are kept open as the rail cars are connected. The noise from the unloading is audible on Victoria Street near the unloading building. However, the noise is not audible at the receptor locations on 17th Street, nor is it audible at Manitoba Hydro's Cornwallis office building.

- *Coal Crusher Building:* The coal crusher is enclosed inside a concrete block building with one door opening to the east. The crusher is located on the second floor of the building with conveyor connections to the building on both the south (from unloading building) and north (to the boiler building) sides. Under normal steady operation mode, the door to the crusher building is kept closed. The noise from the crusher with the door closed is only audible in the close vicinity of the building. The crusher noise is not audible at the closest property boundary.

- *Combustion Turbine Building:* There are two independently operated gas turbine (combustion turbine Units #6 and #7) Units enclosed in the combustion turbine building. Each turbine and generator set is contained within a sealed enclosure. The main building has two overhead bay doors that open to the east. The exhaust from each combustion turbine goes through a 36 m high stack (diameter of ~5 m) located adjacent to the east side of the building. The start-up of the gas turbines is short in duration (~30 minutes) and unlike the coal-fired Unit #5, no high noise emissions are associated with the start-up. When operational, the major noise sources (in addition to the noise from natural gas

pressure reducer, and conditioner system) are the stacks. The noise associated with the stacks is a low-frequency rumble that can be heard at the Cornwallis building, but is not audible at the receptor locations on 17th Street. The vibrating parts of the stack (e.g., platforms and side ladders) also create noise. During this study, it was noticed that a broken weld on the ladder cage of Unit #6 stack was making a distinct squeaking noise.

- *Mobile On-site Equipment:* The facility utilizes a front-end loader and two scrapers to move and organize the coal stockpiles, located south of the Unit #5 cooling tower. This equipment normally operates when the coal crushing and handling systems are working, in which case the dominant noise sources to the east of the coal handling system are the dust collectors. When unloading the coal cars, an on-site shunt is used to move the coal cars in and out of the unloading building. The noise associated with this operation is audible along Victoria Street, adjacent to the railway but not at the receptor locations along 17th Street.

3.0 REGULATORY REQUIREMENTS

3.1 PROVINCE OF MANITOBA REQUIREMENTS

The Brandon Generating Station must comply with the requirements as set out in its Environment Act Licence No. 1703 R, issued October 4, 1993, pursuant to the Manitoba Environment Act. Clause 13 of the Licence states that:

> "*The licencee shall limit sound emissions from all sources on the plant site to the degree that sound levels, when measured off the plant site in any area zoned industrial, does not exceed an Leq(1) of 70 dBA at any time, where the sound level determinations are based on measurements that exclude any significant interfering sounds from other sources off the plant site,…"*

The Licence makes no reference to areas zoned residential, however, Manitoba facilities operating under older licences may be required to meet the numerical sound level limits outlined in the province's Guidelines for Sound Pollution, and listed in Table 3.1 below.

TABLE 3.1
ENVIRONMENTAL SOUND LEVEL OBJECTIVES
CONTINUOUS OR INTERMITTENT SOUNDS

LOCATION	Leq (1) (DAY) 7:00 A.M. TO 10:00 P.M.	Leq (1) (NIGHT) 10:00 P.M. T0 7:00 A.M.
RESIDENTIAL AREA		
(a) Maximum Desirable	55	45
(b) Maximum Acceptable i) Summer or year round operations	60	50
ii) Predominant discrete tone (s) or appreciable impulsive/impact character	55	45
iii) Winter operations only or temporary operations	65	55
COMMERCIAL AREA		
Maximum Desirable	55	45
Maximum Acceptable	70	60
INDUSTRIAL AREA		
Maximum Desirable	70	70
Maximum Acceptable	70	70

As is discussed in Attachment A, the Maximum Desirable limits are identical to the World Bank Guidelines[1] for noise levels in residential settings, but less stringent than Ontario's minimum daytime and evening sound level limits.

[1] The World Bank Guidelines for noise are consistent with the latest technical information on the effects of noise on human health from the World Health Organization.

4.0 SPOT MEASUREMENT DATA

Spot measurements were collected at various on-site noise sources using a RION NA-27 precision integrating sound level meter, equipped with a real-time 1/1 and 1/3 octave band analyzer. The measurement of sound pressure levels for all the on-site noise sources was conducted during both start-up and normal, steady operation. In addition, since most of the continuous noise sources are inside the plant building, spot measurement of sound pressure levels were carried out while the doors were open, as well as when they were closed.

The locations and the conditions under which the spot measurements were taken (i.e., plant status, door open/closed) are summarised in Table 4.1. Measurement locations and the location of the closest receptors are also illustrated in Figures 4.1 and 4.2, respectively. Note that the data IDs presented in Figure 4.1 correspond to those listed in Table 4.1.

The spot measurement data for the audible range of frequencies (25 Hz to 10 kHz) are presented in Table B-1, Attachment B. The data points are numbered according to the location of the measurement, as per Table 4.1.

TABLE 4.1
DESCRIPTION OF SPOT MEASUREMENTS TAKEN AT BRANDON GENERATING STATION

Sample ID	Location Description	Dominant noise source(s)	Distance to main noise source (m)	Plant Status	door	Comment
67	unloading building dust collector system	main exhaust and pulsating noise from filter cleaning system	3	dust collector operating	n/a	
68	unloading building dust collector system	main exhaust and pulsating noise from filter cleaning system	1	dust collector operating	n/a	
69	unloading building dust collector system	main exhaust and pulsating noise from filter cleaning system	10	dust collector operating	n/a	
70	crusher building dust collector system	main exhaust and pulsating noise from filter cleaning system	1	dust collector operating	n/a	
71	crusher building dust collector system	main exhaust and pulsating noise from filter cleaning system	10	dust collector operating	n/a	
72	Transformer yard	closest to generator transformer	1	all transformers energized	n/a	
73	Transformer yard	closest to generator transformer	10	all transformers energized	n/a	
74	Transformer yard	closest to generator transformer	10	all transformers energized	n/a	
75	Transformer yard	closest to generator transformer	1	all transformers energized	n/a	

TABLE 4.1
DESCRIPTION OF SPOT MEASUREMENTS TAKEN AT BRANDON GENERATING STATION

Sample ID	Location Description	Dominant noise source(s)	Distance to main noise source (m)	Plant Status	door	Comment
76	Transformer yard	closest to station service transformer	1	all transformers energized	n/a	
77	Transformer yard	closest to station service transformer	10	all transformers energized	n/a	
78	Transformer yard	closest to station service transformer	10	all transformers energized	n/a	
79	front bay door of turbine hall (facing East)	steam vents, fans and pumps inside the building	0	start-up	open	steam pressure ~4MPa, turbine turning slow (warm-up)
80	front bay door of turbine hall (facing East)	steam vents, fans and pumps inside the building	0	start-up	open	steam pressure ~4.5 MPa, turbine RPM~500
81	front bay door of turbine hall (facing East)	steam vents, fans and pumps inside the building	10	start-up	open	steam pressure ~4.5 MPa, turbine RPM~500
82	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	0	start-up	open	steam pressure ~4.5 MPa, turbine RPM~500
83	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	10	start-up	open	steam pressure ~6.5 MPa, turbine RPM~1000
84	Boiler building rooftop (highest elevation)	main steam drain vent (from blow down vessel)	2	start-up	n/a	steam pressure ~6.5 Mpa
85	Boiler building rooftop (highest elevation)	main steam drain vent (from blow down vessel)	0	start-up	n/a	steam pressure ~6.5 Mpa
86	Boiler building rooftop (highest elevation)	main steam drain vent (from blow down vessel)	10	start-up	n/a	steam pressure ~6.5 Mpa
87	next to main steam vent muffler inside the building (top floor)	steam flow through the muffler	3	start-up	n/a	steam pressure ~6.5 Mpa
88	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	0	start-up	open	steam pressure ~6.5 MPa, turbine RPM~1000
89	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	10	start-up	open	steam pressure ~6.5 MPa, turbine RPM~1000
90	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	0	start-up	closed	steam pressure ~6.5 MPa, turbine RPM~1000
91	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	10	start-up	closed	steam pressure ~6.5 MPa, turbine RPM~1000
92	next to main steam vent muffler inside the building (top floor)	steam flow through the muffler	3	start-up	n/a	steam pressure ~9 Mpa
93	Boiler building rooftop (highest elevation)	main steam drain vent (from blow down vessel)	2	start-up	n/a	steam pressure ~9 Mpa
94	Boiler building rooftop (highest elevation)	main steam drain vent (from blow down vessel)	10	start-up	n/a	steam pressure ~9 Mpa
95	Next to the blow-down vessel inside the boiler building (main floor)	blow-down vessel	1	start-up	n/a	steam pressure ~9 MPa, turbine RPM~3600

TABLE 4.1
DESCRIPTION OF SPOT MEASUREMENTS TAKEN AT BRANDON GENERATING STATION

Sample ID	Location Description	Dominant noise source(s)	Distance to main noise source (m)	Plant Status	door	Comment
96	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	0	start-up	open	steam pressure ~9 MPa, turbine RPM~3600
97	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	10	start-up	open	steam pressure ~9 MPa, turbine RPM~3600
98	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	0	start-up	closed	steam pressure ~9 MPa, turbine RPM~3600
99	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building	10	start-up	closed	steam pressure ~9 MPa, turbine RPM~3600
100	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building and a 3" steam vent, venting outside the bay door	0	start-up	open	steam pressure ~9 MPa, turbine RPM~3600
101	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building and a 3" steam vent, venting outside the bay door	10	start-up	open	steam pressure ~9 MPa, turbine RPM~3600
102	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building and a 3" steam vent, venting outside the bay door	0	start-up	closed	steam pressure ~9 MPa, turbine RPM~3600
103	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building and a 3" steam vent, venting outside the bay door	10	start-up	closed	steam pressure ~9 MPa, turbine RPM~3600
104	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building and a 3" steam vent closed off	0	start-up	closed	steam pressure ~6.5 MPa, turbine RPM~3600
105	front bay door of turbine hall (facing East)	steam vents, fans, pumps and turbine (Unit 5) inside the building and a 3" steam vent closed off	10	start-up	closed	steam pressure ~6.5 MPa, turbine RPM~3600
106	Inside the plant between two coal pulverizers	2 coal pulverizers	2	start-up	n/a	The measurements were taken at the start-up of pulverizing operation which is the noisiest due to the machines starting up empty.
107	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	0	start-up	open	2 pulverizers operating
108	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	10	start-up	open	2 pulverizers operating
109	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	0	start-up	closed	2 pulverizers operating
110	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	10	start-up	closed	2 pulverizers operating
111	Combustion Turbines' (CT) Transformer yard	Transformers (2 unit transformers and 2 service station transformers)	~3	n/a	n/a	All four transformers energized
112	Combustion Turbines' (CT) Transformer yard	Transformers (2 unit transformers and 2 service station transformers)	10	n/a	n/a	All four transformers energized
113	CT cooling tower (dry)	cooling tower fans (4 fans)	0	start-up	n/a	The CT was not operating during this noise measurement (noise only from the cooling tower)
114	CT cooling tower (dry)	cooling tower fans (4 fans)	10	start-up	n/a	The CT was not operating during this noise measurement (noise only from the cooling tower)

TABLE 4.1
DESCRIPTION OF SPOT MEASUREMENTS TAKEN AT BRANDON GENERATING STATION

Sample ID	Location Description	Dominant noise source(s)	Distance to main noise source (m)	Plant Status	door	Comment
115	Fuel gas knock out vessel	Fuel gas knock out vessel	1	operating	n/a	CT operating at 96 MW (RPM = 3600)
116	Fuel gas knock out vessel	Fuel gas knock out vessel	10	operating	n/a	CT operating at 96 MW (RPM = 3600)
117	Fuel gas conditioner heater	blow fan and some noise contribution from the fuel gas knock out vessel	1	operating	n/a	CT operating at 96 MW (RPM = 3600)
118	Fuel gas conditioner heater	blow fan and some noise contribution from the fuel gas knock out vessel	10	operating	n/a	CT operating at 96 MW (RPM = 3600)
119	At the foot of CT stack (CT Unit 6) facing east	CT stack (Unit 6)	1	operating	closed	CT operating at 96 MW (RPM = 3600)
120	At the foot of CT stack (CT Unit 6) facing east	CT stack (Unit 6)	10	operating	closed	CT operating at 96 MW (RPM = 3600)
121	On the first platform, up the CT stack	CT stack (Unit 6)	0	operating	closed	CT operating at 96 MW (RPM = 3600)
122	On the second platform, up the CT stack	CT stack (Unit 6)	0	operating	closed	CT operating at 96 MW (RPM = 3600)
123	On the top platform, facing east	CT stack (Unit 6)	0	operating	closed	CT operating at 96 MW (RPM = 3600)
124	On the top platform, facing west	CT stack (Unit 6)	0	operating	closed	CT operating at 96 MW (RPM = 3600)
125	On the top platform, facing North	CT stack (Unit 6)	0	operating	closed	CT operating at 96 MW (RPM = 3600)
126	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	0	start-up	open	3 pulverizers operating Unit 5 output ~ 100 MW
127	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	10	start-up	open	3 pulverizers operating Unit 5 output ~ 100 MW
128	Inside the plant near coal pulverizers	3 coal pulverizers	2	start-up	n/a	
129	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	0	start-up	closed	3 pulverizers operating
130	Side bay door of the boiler building (facing North)	pulverizers, blow-down vessel, plant air compressors, pumps and fans	10	start-up	closed	3 pulverizers operating
131	At the Unit 5 (coal-fired unit) wet cooling tower	The cooling tower	1	operating	n/a	
132	At the Unit 5 (coal-fired unit) wet cooling tower	The cooling tower	15	operating	n/a	
133	Inside the CT building near the exit point of CT exhaust	exhaust manifold	1	operating	n/a	
134	At the foot of CT stack (CT Unit 6) facing east	CT stack (Unit 6)	1	operating	closed	CT operating at 75 MW (RPM = 3600)

TABLE 4.1
DESCRIPTION OF SPOT MEASUREMENTS TAKEN AT BRANDON GENERATING STATION

Sample ID	Location Description	Dominant noise source(s)	Distance to main noise source (m)	Plant Status	door	Comment
135	Inside the CT building near the generator end of Unit 6	fans, CT, generator	1	operating	n/a	CT operating at 75 MW (RPM = 3600)
136	At the foot of CT stack (CT Unit 7) facing east	Blow-out valve venting through the main stack	1	start-up	closed	
137	At the foot of CT stack (CT Unit 7) facing east	Blow-out valve venting through the main stack	2	start-up	closed	
138	At the foot of CT stack (CT Unit 7) facing east	Blow-out valve venting through the main stack	10	start-up	closed	
139	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7)	1	start-up	closed	unit running at 3600 RPM with output of 37 MW
140	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7)	10	start-up	closed	unit running at 3600 RPM with output of 37 MW
141	Inside the CT building near the generator end of Unit 7	fans, CT, generator	1	operating	n/a	RPM = 3600
142	At the foot of the CT Stack (unit 7) side ladder	CT stack Unit 7 and vibration of side ladder				Broken weld of the side ladder resulted in increased noise emitted from vibration of side ladder
143	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7)	1	operating	closed	unit running at 3600 RPM with output of 75 MW
144	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7)	10	operating	closed	unit running at 3600 RPM with output of 75 MW
145	In the parking lot of Manitoba Hydro's Cornwallis office building (~500 m east of the plant)	Audible noise mainly from Unit 7 (low frequency noise from the CT stack)	~500	operating	closed	measurements were taken facing the plant (west)
146	In the west windows of Cornwallis office building (~520 m east of the plant)	Audible noise mainly from Unit 7 (low frequency noise from the CT stack)	~520	operating	closed	measurements were taken facing the plant (west)
147	On the west side of 17th St. facing the plant	No audible noise from the plant. Humming noise from the nearby switchyard audible.	~20	operating	n/a	The measurement was taken during nighttime (Unit 5 and Unit 7 operating) with the major noise source being the switchyard at the southwest corner of Victoria St. and 17th St.
148	At the fence line of the Switchyard located southwest of Victoria St. and 17th St.	Switchyard transformers	~5	n/a	n/a	
149	Inside the coal car unloading building	Vibrating empty coal car	1	operating	n/a	The measurement was taken with the two shakers, shaking a coal car.
150	At the east bay door of coal unloading building	Vibrating empty coal car	0	operating	open	
151	At the east bay door of coal unloading building	Vibrating empty coal car	10	operating	open	
152	Inside the coal car unloading building	Vibrating empty coal car	0	operating	open	
153	At the west bay door of coal unloading building	Vibrating empty coal car	0	operating	open	

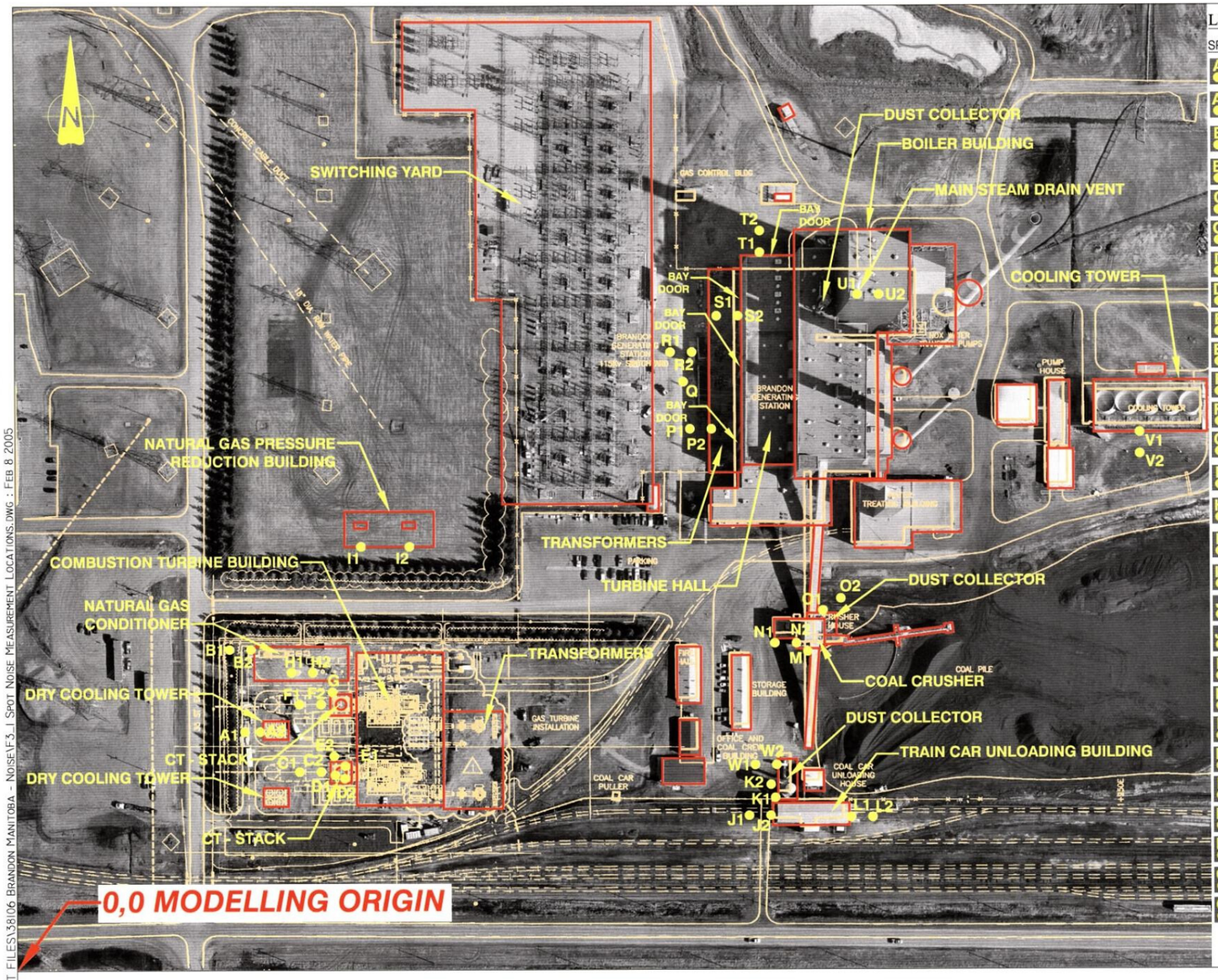
TABLE 4.1
DESCRIPTION OF SPOT MEASUREMENTS TAKEN AT BRANDON GENERATING STATION

Sample ID	Location Description	Dominant noise source(s)	Distance to main noise source (m)	Plant Status	door	Comment
154	At the west bay door of coal unloading building	Vibrating empty coal car	10	operating	open	
155	At the west bay door of coal unloading building	Vibrating empty coal car	0	operating	closed	
156	At the west bay door of coal unloading building	Vibrating empty coal car	10	operating	closed	
158	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7) & vibration of the side ladder and the platforms	1	operating	closed	unit running at 3600 RPM with output of 100 MW
159	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7) & vibration of the side ladder and the platforms	10	operating	closed	unit running at 3600 RPM with output of 100 MW
160	On the top platform, facing east	CT Stack (unit 7) & vibration of the side ladder and the platforms	0	operating	n/a	CT operating at 135 MW (RPM = 3600)
161	On the top platform, facing west	CT Stack (unit 7) & vibration of the side ladder and the platforms	0	operating	n/a	CT operating at 135 MW (RPM = 3600)
162	On the top platform, facing North	CT Stack (unit 7) & vibration of the side ladder and the platforms	0	operating	n/a	CT operating at 135 MW (RPM = 3600)
163	On the first platform, up the CT stack	CT Stack (unit 7) & vibration of the side ladder and the platforms	0	operating	closed	CT operating at 135 MW (RPM = 3600)
164	On the second platform, up the CT stack	CT Stack (unit 7) & vibration of the side ladder and the platforms	0	operating	closed	CT operating at 135 MW (RPM = 3600)
165	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7) & vibration of the side ladder and the platforms	1	operating	closed	CT operating at 135 MW (RPM = 3600)
166	At the foot of CT stack (CT Unit 7) facing east	CT Stack (unit 7) & vibration of the side ladder and the platforms	10	operating	closed	CT operating at 135 MW (RPM = 3600)
167	At the fence line of the gas-pressure reducer enclosure	gas pressure reducer	8	operating	n/a	The CT Unit 7 operating under full load (135 MW)
168	At the fence line of the gas-pressure reducer enclosure	gas pressure reducer	8	operating	open	The CT Unit 7 operating under full load (135 MW)
169	At the doorway (man way) to the coal crusher building	coal crusher operating	0	operating	open	
170	Under the conveyor connection to the crusher building	conveyor and crusher	10	operating	n/a	
171	At the main double doorway to the crusher building	crusher	0	operating	open	
172	At the main double doorway to the crusher building	crusher	10	operating	open	
173	At the main double doorway to the crusher building	crusher	0	operating	closed	
174	At the main double doorway to the crusher building	crusher	10	operating	closed	

TABLE 4.1
DESCRIPTION OF SPOT MEASUREMENTS TAKEN AT BRANDON GENERATING STATION

Sample ID	Location Description	Dominant noise source(s)	Distance to main noise source (m)	Plant Status	door	Comment
175	ignore					
176	Locomotive under load (when moving a full coal car)	locomotive engine & rail cars	10	operating	n/a	
177	ignore					
178	Second switchyard to the east of the plant (near Cornwallis bldg)	transformers (total of 4 transformers)	15	operating	n/a	All four transformers energized

Note: The highlighted cell is for a measurement that was done at the request of Manitoba Hydro and was not used in estimation of noise levels outside of the unloading building.



LEGEND

SPOT NOISE MEASUREMENT LOCATION

- A1 SPOT MEASUREMENT ID# 114.
- A2 SPOT MEASUREMENT ID# 113.
- B1 SPOT MEASUREMENT ID# 118.
- B2 SPOT MEASUREMENT ID# 117.
- C1 SPOT MEASUREMENT ID# 138, 140, 159.
- C2 SPOT MEASUREMENT ID# 136, 139, 158.
- D1 SPOT MEASUREMENT ID# 160.
- D2 SPOT MEASUREMENT ID# 161.
- E1 SPOT MEASUREMENT ID# 162.
- E2 SPOT MEASUREMENT ID# 142.
- F1 SPOT MEASUREMENT ID# 120.
- F2 SPOT MEASUREMENT ID# 119.
- G SPOT MEASUREMENT ID# 122.
- H1 SPOT MEASUREMENT ID# 116.
- H2 SPOT MEASUREMENT ID# 115.
- I1 SPOT MEASUREMENT ID# 167.
- I2 SPOT MEASUREMENT ID# 168.
- J1 SPOT MEASUREMENT ID# 151.
- J2 SPOT MEASUREMENT ID# 150.
- K1 SPOT MEASUREMENT ID# 175.
- K2 SPOT MEASUREMENT ID# 176.
- L1 SPOT MEASUREMENT ID# 153,155.
- L2 SPOT MEASUREMENT ID# 154, 156.
- M SPOT MEASUREMENT ID# 177.
- N1 SPOT MEASUREMENT ID# 172, 174.
- N2 SPOT MEASUREMENT ID# 169, 171, 173.
- O1 SPOT MEASUREMENT ID# 70.
- O2 SPOT MEASUREMENT ID# 71.
- P1 SPOT MEASUREMENT ID# 77, 78.
- P2 SPOT MEASUREMENT ID# 76.
- Q SPOT MEASUREMENT ID# 112.
- R1 SPOT MEASUREMENT ID# 74.
- R2 SPOT MEASUREMENT ID# 72, 73.
- S1 SPOT MEASUREMENT ID# 81, 83.
- S2 SPOT MEASUREMENT ID# 80, 82.
- T1 SPOT MEASUREMENT ID# 88, 90, 96, 98, 107, 109, 126, 129.
- T2 SPOT MEASUREMENT ID# 89, 91, 97, 99, 108, 110, 127, 130.
- U1 SPOT MEASUREMENT ID# 85, 93.
- U2 SPOT MEASUREMENT ID# 86, 94.
- V1 SPOT MEASUREMENT ID# 31.
- V2 SPOT MEASUREMENT ID# 132.

M.T.N. : E:\PROJECT FILES\38106 BRANDON MANITOBA - NOISE\F3_1 SPOT NOISE MEASUREMENT LOCATIONS.DWG : FEB 8 2005

BASE MAP SOURCE: MONITOBA HYDRO. BRANDON GENERATING STATION SURVEY CONTROL AT STATION SITE, No. 7-00109-DE-11520-0005, OCT 24, 2003.

FIGURE 6-X

BRANDON GENERATING STATION
SPOT NOISE MEASUREMENT LOCATIONS

FIGURE 4.2
SELECTED CLOSEST RECEPTOR LOCATIONS
BRANDON THERMAL GENERATING STATION

5.0 SOUND LEVEL MODELLING

5.1 PREDICTION METHOD

The acoustical modeling for this project was completed using the Computer Aided Noise Abatement (CADNA-A) model, developed by DataKustik. The outdoor noise propagation model is based on ISO 9613, Part 1: Calculation of the absorption of sound by the atmosphere, 1993 and Part 2: General method of calculation (ISO 9613-2:1996).

For the purpose of the noise modelling, the atmospheric conditions were assumed to be calm (i.e., no wind), at 10 °C and 70% relative humidity. The ground absorption coefficient G was conservatively set to 0.20, which corresponds to a fairly reflective ground.

The number of reflections for the model was set at three. This implies that three reflections from buildings and obstacles were allowed for individual acoustic rays during propagation calculations. For complex installations with a large number of buildings and obstacles, the reflected energy component can be considerable. Specifying a sufficiently large number of allowed reflections ensures that the contributions at the receptors are not understated. Thus, three is reasonable for the site.

5.2 RESULTS OF SOUND LEVEL MODELLING

For the purpose of this report, the CADNA-A model was run for two operational modes:

a) Start-up mode; and
b) Regular steady operation mode.

5.2.1 START-UP MODE

The sound levels associated with the BGS is different during the start-up than during its normal steady operation. The noise levels are expected to be slightly higher, mainly due to venting of high-pressure steam from the blow-down tank for Unit #5. Therefore, for the purpose of this modelling study, the noise levels during the start-up were modelled separately.

For the start-up mode, the major noise sources are as follows:

1) Steam vent (boiler bldg. Roof-top);
2) Transformers of the combustion turbines (CT);
3) Plant noise leaking through open doors of the turbine hall - West;
4) Plant noise leaking through open doors of the turbine hall - North;
5) Main transformers;

6) Wet cooling tower – Unit #5;
7) Dry cooling tower of combustions turbine;
8) Fuel conditioner of the combustion turbine;
9) Crusher building;
10) Crusher building dust collector;
11) Coal handling of rail cars; and
12) Gas pressure reducer building.

For the start-up mode, the source specifications, including source height and coordinates are summarized in Table 5.1.

TABLE 5.1
NOISE SOURCE SPECIFICATIONS & COORDINATES (START-UP MODE)

Name	ID	Height (m)	Result. PWL (dBA)		Coordinates (m)		
			Day	Night	X	Y	Z
Steam Vent (boiler bldg. Roof-top)	SV1	51	118.7	118.7	1593.22	718.32	51
Turbine Hall West Doors	THE1	4	101	101	1535.65	727.63	4
Turbine Hall North Doors	THN1	4	101.1	101.1	1544.96	737.79	4
Main Transformer #1	MT1	2.5	74.9	74.9	1520.41	693.76	2.5
Main Transformers #2	MT2	2.5	58.7	58.7	1520.41	666.67	2.5
CT Dry Cooling tower #1	CTCT1	4	92.5	92.5	1319.75	510.88	4
CT Dry Cooling Tower#2	CTCT2	4	92.5	92.5	1318.9	478.71	4
Wet Cooling Tower - Unit 5	WCT1	5	112.5	112.5	1704.98	660.74	5
CT Transformers	CTT1	2.5	67.5	67.5	1415.42	499.03	2.5
Gas Conditioner	GC1	3	99.9	99.9	1309.59	529.51	3
Dust Collector - Crusher Bldg.	DC2	12	123.1	123.1	1583.91	560.84	12
Crusher Bldg.	CB1	4	95.6	95.6	1558.51	558.3	4
Coal Handling Bldg.	CH1	4	107.6	107.6	1549.19	471.94	4
Gas Pressure Reducer Bldg.	GR1	3	82.3	82.3	1349.38	606.56	3

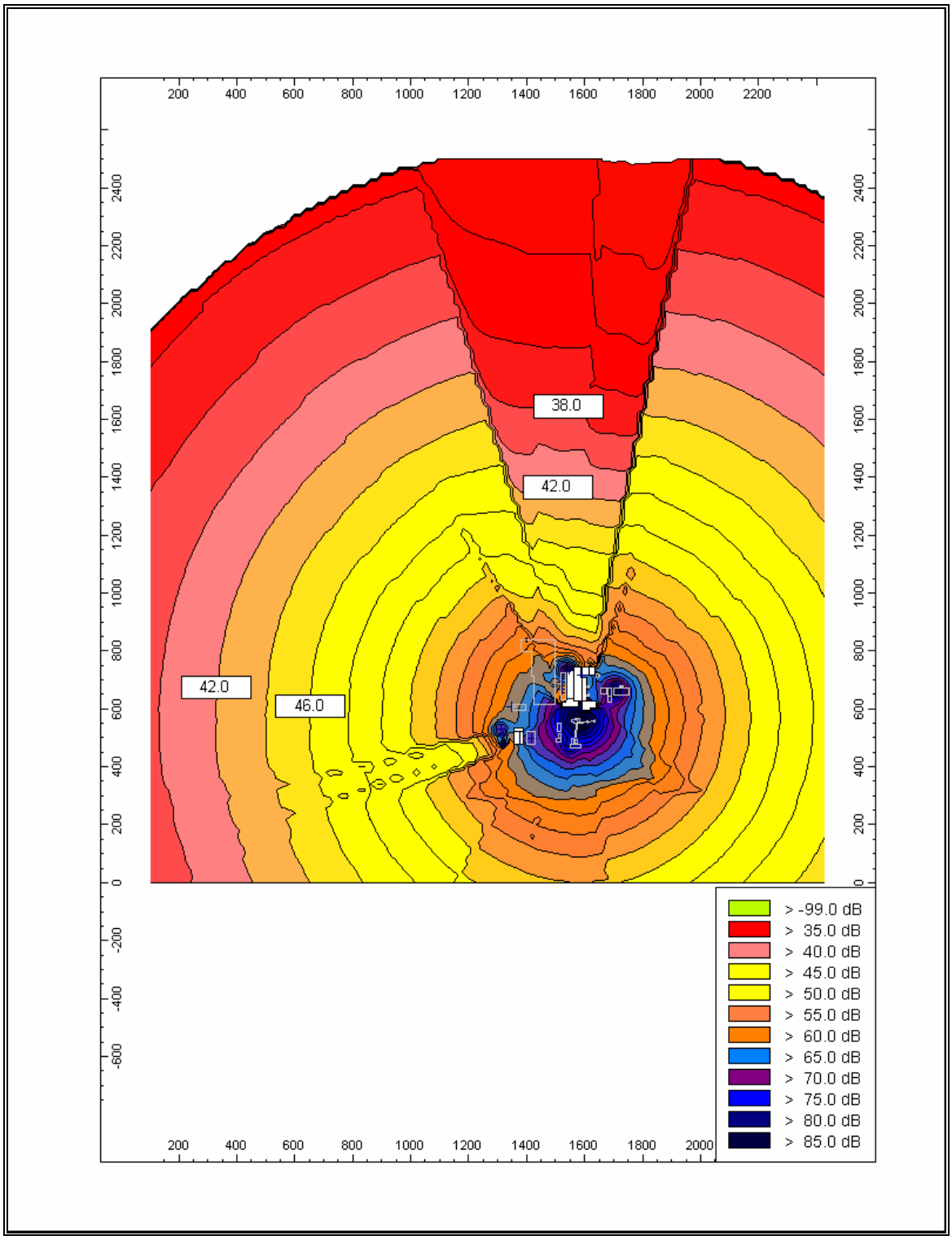
The Octave spectra of sound power levels evaluated from the spot measurements during the start-up mode are summarized in Table 5.2. These values were input into the CADNA-A model.

TABLE 5.2
SOURCE SOUND POWER LEVELS (START-UP MODE)

	Octave Spectrum (dB)										
Frequency (Hz)	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**A**	**lin**
Source Name											
Steam Vent (boiler bldg. Roof-top)	103.1	101.6	107.3	102.8	94.7	101.3	111.1	114.6	113.8	118.7	118.9
Turbine Hall West Door	86.6	97.3	86.9	84.2	87.3	93.6	96.4	94.9	84.6	101	102.3
Turbine Hall North Door	79.8	96.4	91.6	95.2	95	97.4	94.2	90.8	86.6	101.1	103.5
CT Transformers	68.8	65	75.7	59.1	69.4	54.5	46.4	42.1	40.6	67.5	77.6
Main Transformers	64.4	62.4	81.7	72.6	75.6	67.6	60.2	53.3	47.6	74.9	83.3
Main Transformer 2	73.5	56.8	57.6	58.8	49.3	51.5	50.6	53.2	44.6	58.7	73.9
Wet Cooling Tower, Unit 5	110.4	106.8	109.1	106.6	101.3	99	104.3	106.9	108.7	112.5	116.6
CT Cooling Tower	89.4	92.3	91.2	90.7	91.8	88.9	77.5	67.7	63.2	92.5	98.7
Fuel Conditioners	106.4	90	83.1	82.6	90.1	96.4	95.3	85.9	73	99.9	107.3
Crusher Bldg. Dust Collector-2	109.2	107.7	115.7	111.9	117.5	116.5	118.9	112.7	105.6	123.1	124.3
Coal Handling Cars	110.4	113.2	111.2	105	103.2	100.5	101.8	97.9	89.5	107.6	117.3
Gas Pressure Reducer Bldg.	91.4	79.8	73.1	62.2	58.2	65.1	66.6	78.2	79.9	82.3	92.2
Crusher Bldg.	108.8	98.9	96	93.7	90.2	90.2	89.7	85.1	74.7	95.6	109.7

The modelled sound level contours and the predicted sound levels at the closest receptor locations, for the start-up mode are presented in Figure 5.1**.** Although noise from only one of the CTs was included in the modelling, the inclusion of a second CT would not result in a significant increase in predicted noise levels at the receptor locations.

FIGURE 5.1
SOUND LEVEL CONTOURS FOR THE START-UP MODE AT BRANDON GENERATING STATION



5.2.2 Regular Steady Operation Mode

Under the regular steady operation mode, in order to model the worst-case noise emission scenario, the sound power levels that were measured with the plant doors open were used in the modelling.

The regular steady state operations included the following sources:

1) One CT stack noise source;
2) Transformers of the combustion turbines;
3) Plant noise leaking through open doors - West;
4) Plant noise leaking through open doors North;
5) Main transformers;
6) Wet cooling tower – Unit #5;
7) Dry cooling tower of combustions turbine;
8) Fuel conditioners of the combustion turbines;
9) Crusher building;
10) Crusher building dust collector – DC2;
11) Coal handling of rail cars; and
12) Gas reducers.

Although noise from only one of the CTs was included in the modelling, the inclusion of a second CT would not result in a significant increase in predicted noise levels at the receptor locations.

TABLE 5.3
NOISE SOURCE SPECIFICATIONS & COORDINATES
(REGULAR STEADY OPERATION MODE)

Name	ID	Height (m)	Result. PWL (dBA)		Coordinates (m)		
			Day	Night	X	Y	Z
Turbine Hall West	THE1	4	101	101	1535.65	727.63	4
Turbine Hall North	THN1	4	101.1	101.1	1544.96	737.79	4
Main Transformer	MT1	2.5	74.9	74.9	1520.41	693.76	2.5
Main Transformers	MT2	2.5	58.7	58.7	1520.41	666.67	2.5
Dry Cooling tower	CTCT1	4	92.5	92.5	1319.75	510.88	4
Dry Cooling Tower	CTCT2	4	92.5	92.5	1318.9	478.71	4
Wet Cooling Tower - Unit 5	WCT1	5	112.5	112.5	1704.98	660.74	5
CT Transformers	CTT1	2.5	67.5	67.5	1415.42	499.03	2.5
Gas Conditioner	GC1	3	99.9	99.9	1309.59	529.51	3
Dust Collector - Crusher Bldg.	DC2	12	123.1	123.1	1583.91	560.84	12
Crusher Bldg.	CB1	4	95.6	95.6	1558.51	558.3	4
Coal Handling Bldg.	CH1	4	107.6	107.6	1549.19	471.94	4
Gas Reducer	GR1	3	82.3	82.3	1349.38	606.56	3
Combustion Stack - Unit 6	CTS6	29	97.3	97.3	1350.97	510.75	29

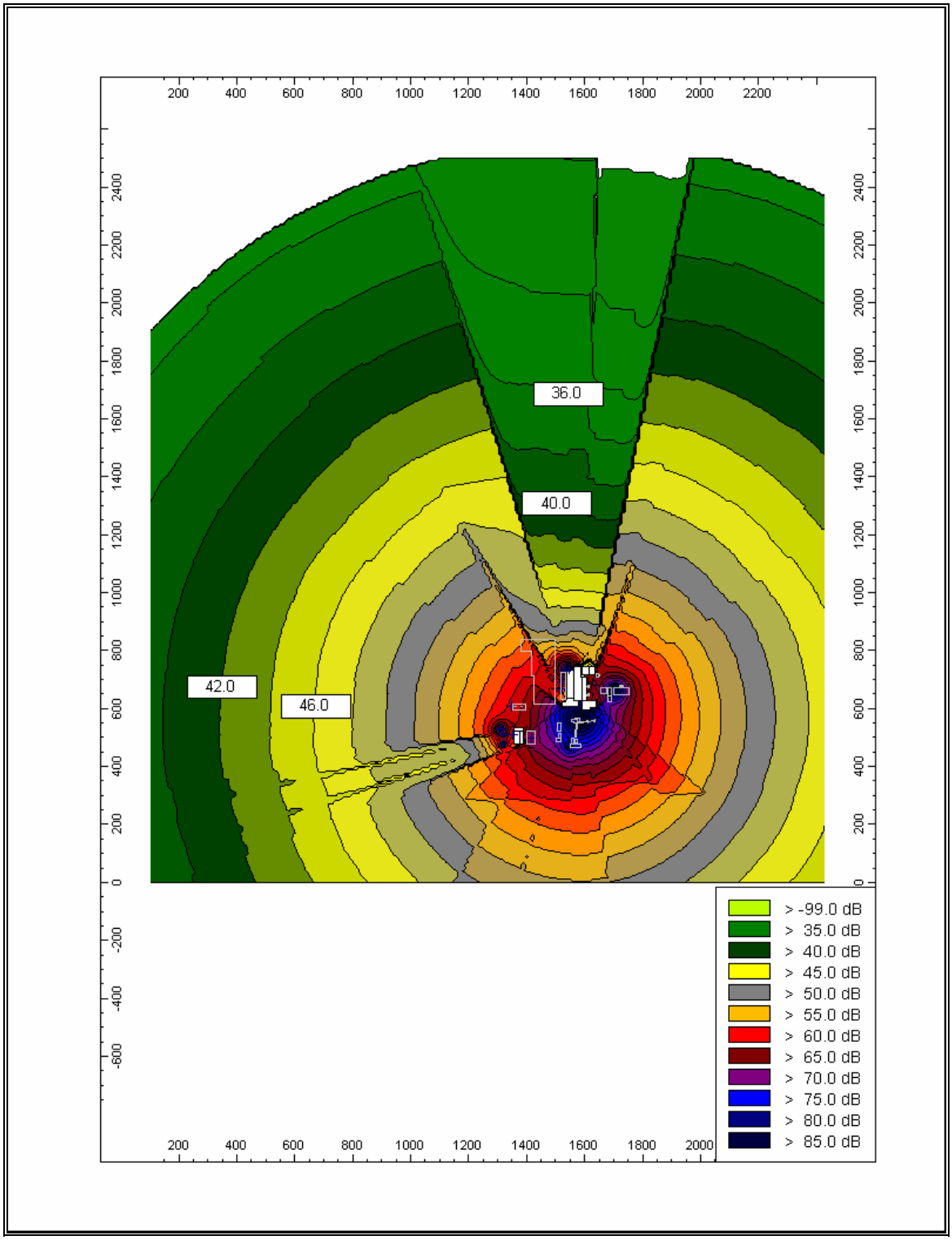
The Octave spectra of sound power levels evaluated from the spot measurements during the steady regular operation mode are summarized in Table 5.4. These values were input into the CADNA-A model.

TABLE 5.4
SOURCE SOUND POWER LEVELS (START-UP MODE)

	Octave Spectrum (dB)										
Frequency (Hz)	**31.5**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**A**	**lin**
Source Name											
Combustion Stack - 6	123.4	113.8	102.9	96.1	96.1	84.6	86.5	87.1	79.3	97.3	123.9
Turbine Hall West Door	86.6	97.3	86.9	84.2	87.3	93.6	96.4	94.9	84.6	101	102.3
Turbine Hall North Door	79.8	96.4	91.6	95.2	95	97.4	94.2	90.8	86.6	101.1	103.5
CT Transformers	68.8	65	75.7	59.1	69.4	54.5	46.4	42.1	40.6	67.5	77.6
Main Transformers	64.4	62.4	81.7	72.6	75.6	67.6	60.2	53.3	47.6	74.9	83.3
Main Transformer 2	73.5	56.8	57.6	58.8	49.3	51.5	50.6	53.2	44.6	58.7	73.9
Wet Cooling Tower, Unit 5	110.4	106.8	109.1	106.6	101.3	99	104.3	106.9	108.7	112.5	116.6
CT Cooling Tower	89.4	92.3	91.2	90.7	91.8	88.9	77.5	67.7	63.2	92.5	98.7
Fuel Conditioners	106.4	90	83.1	82.6	90.1	96.4	95.3	85.9	73	99.9	107.3
Crusher Bldg. Dust Collector-2	109.2	107.7	115.7	111.9	117.5	116.5	118.9	112.7	105.6	123.1	124.3
Coal Handling Cars	110.4	113.2	111.2	105	103.2	100.5	101.8	97.9	89.5	107.6	117.3
Gas Reducer Bldg.	91.4	79.8	73.1	62.2	58.2	65.1	66.6	78.2	79.9	82.3	92.2
Crusher Bldg. Noise	108.8	98.9	96	93.7	90.2	90.2	89.7	85.1	74.7	95.6	109.7

The modelled sound level contours and the predicted sound levels at the closest receptor locations, for the regular steady operation mode are presented in Figure 5.2.

FIGURE 5.2
SOUND LEVEL CONTOURS FOR THE REGULAR STEADY OPERATION MODE AT BRANDON GENERATING STATION



6.0 CONCLUSIONS

The model results presented in Section 5.0 indicate that the model predicted sound level contributions from the BGS, do not influence the noise environment at the selected receptor locations. The model predicts sound levels that are below that stipulated in the operating License (No. 1703 R) for the facility and the daytime and nighttime limits discussed in Chapter 3. A comparison of the two operational modes (start-up and regular steady operation) shows that the predicted noise levels to the north of the facility (where the noise from the main steam drain vent is most noticeable) is marginally higher by approximately 2 dBA during the start-up mode versus the regular steady operation mode.

From the predicted results it can also be concluded that noise leakage from the open doors of the original building (Unit #5) and the coal handling buildings (unloading and crushing) do not contribute to noise levels at the selected receptor locations.

REFERENCES

Cowan, J.P. 1994. Handbook of Environmental Acoustics. Van Nostrand Reinhold, New York.

Manitoba Conservation, 2002. Environment Act Licence No. 1645 RRRR. Manitoba Hydro Selkirk Generating Station.

ATTACHMENT A

BACKGROUND NOISE ASSESSMENT BRANDON THERMAL GENERATING STATION

TABLE OF CONTENTS

LIST OF TABLES