Appendix C.4

Xcel Energy's Supplemental Response to Minnesota Department of Commerce Office of Energy Security, IR No. 102, Docket Nos. E-002/CN-10-694 and E-002/RP-10-825

XcelEnergy

414 Nicollet Mall
Minneapolis, MN 55402

October 18, 2010 **--Via Electronic Filing--**

Alexius Hofschulte
Minnesota Department of Commerce
85 7th Place East, Suite 500
St. Paul, MN 55101

RE: RESPONSE TO OES INFORMATION REQUEST 102
2010 RESOURCE PLAN
DOCKET NO. E002/RP-10-825
DOCKET NO. E002/CN-10-694

Dear Mr. Hofschulte:

Northern States Power Company (the "Company"), a Minnesota corporation, submits the enclosed response to the information request submitted by the Minnesota Office of Energy Security in the above referenced docket. The Information Request was requested by Dr. Steve Rakow in two separate dockets referenced above.

If you have any questions regarding the Company's responses, please call me at (612) 330-6750.

Sincerely,
/s/
MARK SUEL

Enclosure

☐ **Non Public Document – Contains Trade Secret Data**
☐ **Public Document – Trade Secret Data Excised**
☒ **Public Document**

Xcel Energy			
Docket No.:	E002/RP-10-825 and E002/CN-10-694		
Response To:	Office of Energy Security	Information Request No.	102
Analyst:	Steve Rakow		
Date Received:	September 24, 2010		

Question:

Please provide the Strategist Input information regarding a high-efficiency, low-emissions, distributed generation alternative for use in the (non-) base case file provided in Xcel's response to OES Information Request No. 1. For purposes of this answer, assume a typical waste-wood burning power plant sited and sized so as to be able to serve the needs identified in the Hiawatha proceeding. See Minn. Stat. §216B.2426 for the applicable statutory criteria and required consideration in certificate of need and resource plan proceedings.

Commission month and year
Resource type;
Retirement month and year;
Thermal Unit type;
Capacity Segment Profile information;
Deration Library information;
Heat Rate Profile information;
Maintenance Requirement (in weeks per year);
Mature Forced Outage Rate;
Maximum Capacity;
Minimum Capacity;
Must Run Indicator;
Variable O and M Costs;
All information related to fuel if not already included in the database;
Any other information of value regarding the alternative.

Response:
The Company does not have a detailed model of the type of unit requested. Attachment A is provided as a basis for this unit and represents the latest information

the Company has received from vendors in this market. The attached information includes unit costs, performance data, and effluent estimates.

Response By: Michael Jones
Title: Resource Planning Analyst
Department: Quantitative Risk Services
Telephone: (303) 571-7041
Date: October 18, 2010

Attachment to IR 102

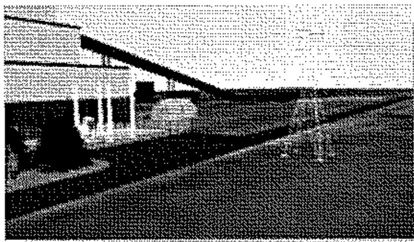
"Mulch to Megawatts"

25 MW Biomass Power Plant

Barr Engineering Company
4700 West 77th Street • Minneapolis, Minnesota 55435
Phone: 952-832-2600 • Fax: 952-832-2601 • www.barr.com

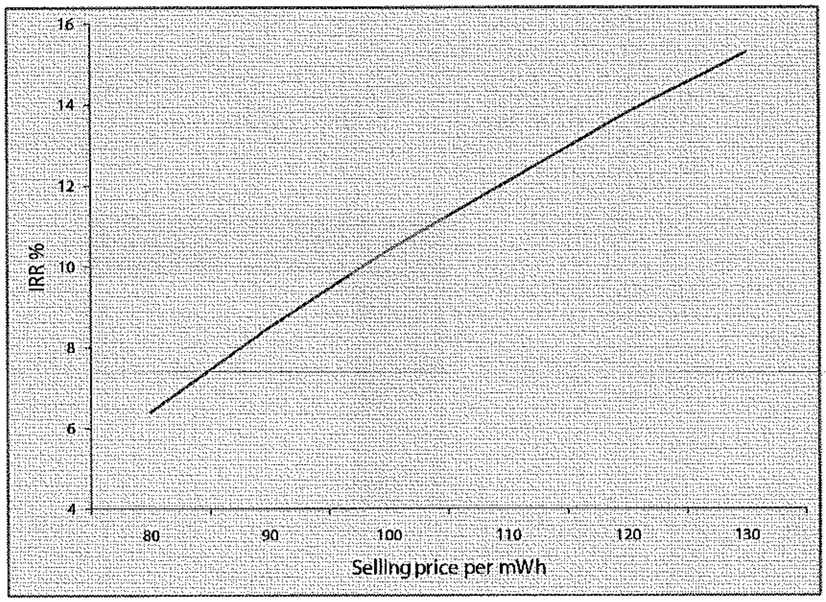
Cook Engineering
740 South Syndicate Ave. • Thunder Bay, Ontario P7E 1E9
Ph: 807-625-6700 • Fax: 807-623-4491 • www.cookeng.com

Biomass Business Strategy



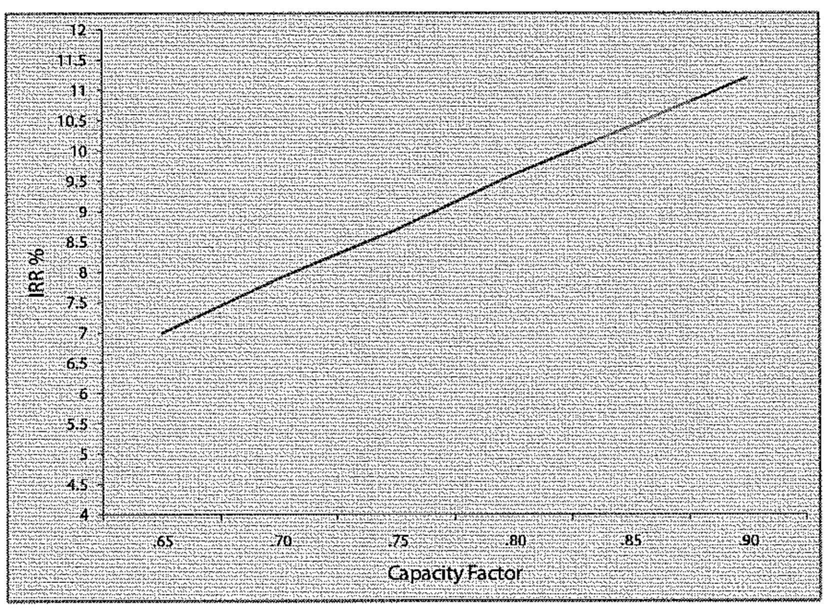
Project life - 25 years
Depreciation - MACRS
Capital cost - $3335 per KW
Fuel cost - $2.50 per MMBTU
Tax Credits - 1.1 cent per KW
IRR - Unleveraged
Staff - 27 personnel

Success = Sustainable Rate of Return



Reliability = High Capacity Factor = High Returns

Utility-grade equipment +
Robust design =
Highest returns



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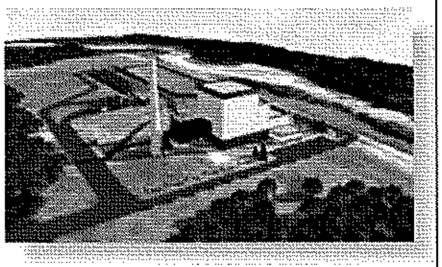
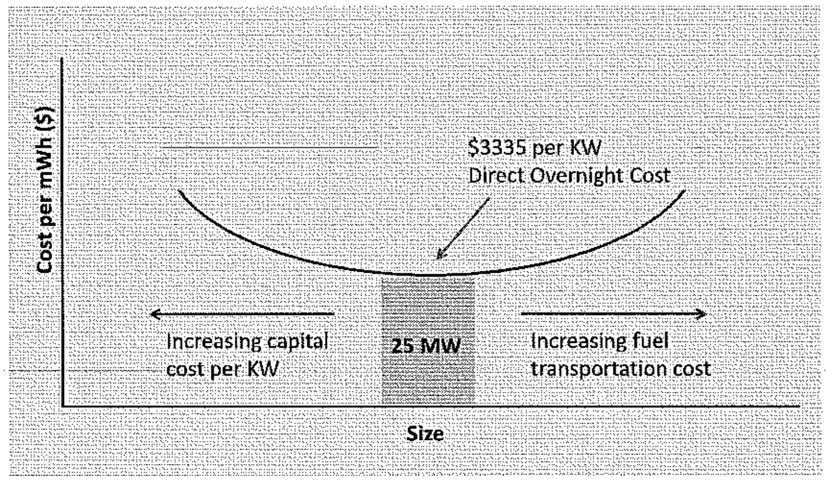
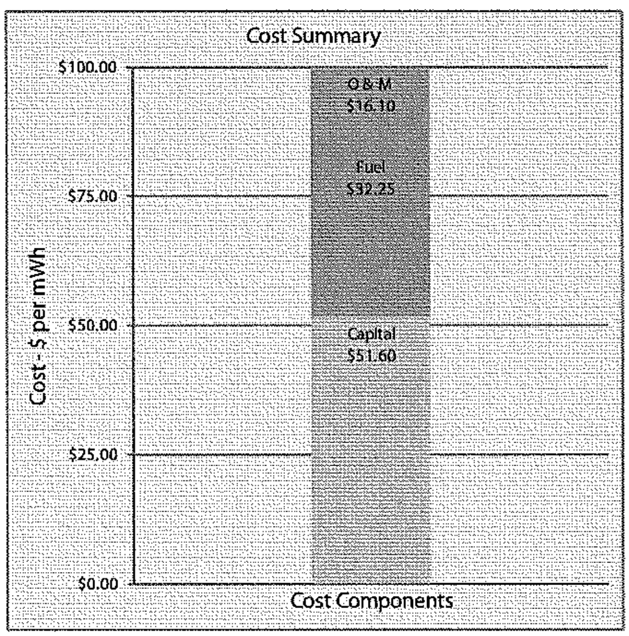


25 MW = Optimum Cost



Assuming a typical biomass supply for a new power plant site, 25 megawatts is an optimal-sized project with respect to capital costs and fuel supply costs. Smaller projects will be more expensive to build (per KW) and larger projects will require a larger fuel-aggregation radius, which may trend toward unsustainable transportation costs. This determination may not hold for projects with their own special advantages, such as repowering of existing assets or having a captive fuel supply in close proximity.



Agricultural residuals, such as wheat straw, can be part of a biomass fuel supply.

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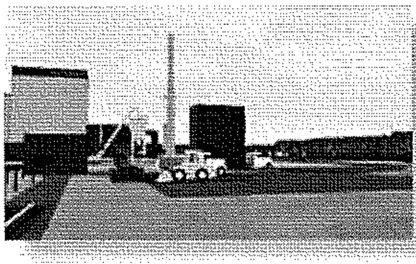
Biomass Fuel Flexibility



Increased Fuel Flexibility = Reduced Project Risk

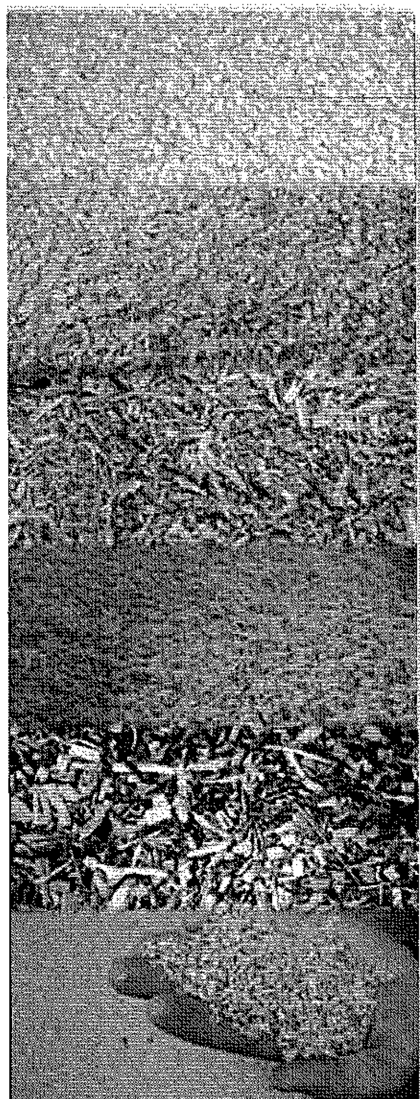
Closed-loop fuels include:
- Switchgrass
- Corn stover
- Hybrid poplars
- Canary grass
- Sorghum
- Animal waste (turkey litter, etc.)

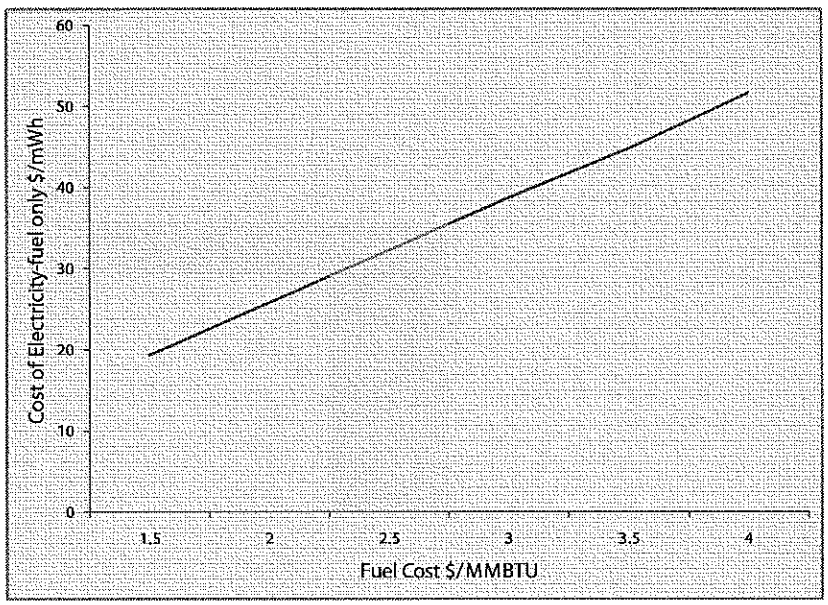
*From Title 26 (Tax Code), Subtitle A, Chapter I, Subchapter A, Part IV, Subpart D, Sec. 45(c)(2): "The term '**closed-loop biomass**' means any organic material from a plant which is planted exclusively for purposes of being used at a qualified facility to produce electricity."*

Open loop fuels include:
- Whole tree chips
- Hog fuel
- Wastewood

* These fuels can be burned singly or in combination.

*From Title 26 (Tax code), Subtitle A, Chapter I, Subchapter A, Part IV, Subpart D, Sec. 45(c)(3): "The term '**open-loop biomass**' means - (i) any agricultural livestock waste nutrients, or (ii) any solid, nonhazardous, cellulosic waste material or any lignin material which is segregated from other waste materials and which is derived from (I) any of the following forest-related resources: mill and harvesting residues, precommercial thinnings, slash, and brush, (II) solid wood waste materials... but not including municipal solid waste, gas derived from the biodegradation of solid waste, or paper which is commonly recycled, or (III) agriculture sources."*





Biomass fuel options include (top to bottom) corn screenings, malt screenings, mustard screenings, oats screenings, hogged wood fuel, and wheat chaff.

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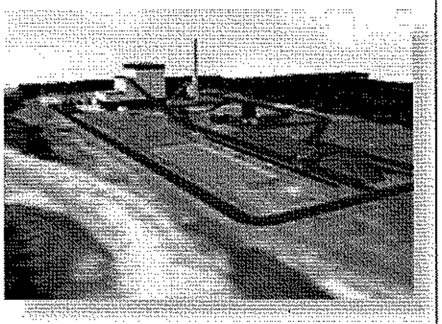
Environmental Impacts



Ash Disposal
- 3,300 tpy
- Land application
- Concrete amendment (possible)
- Industrial landfill

Comprehensive Environmental Evaluation = Straight-forward Permitting

Air-Emission-Control Technologies
- Fabric filter for particulate
- SNCR for NOx

Estimated Air Emissions Profile

	lb per MMBtu*	Heat Input (MMBtu/hr)	Control	Controlled PTE (tpy)**	lb per MMBtu - controlled
PM_{10}	0.1	335	0.9	17.6	0.012
NOx	0.2	335	0.5	147	0.10
CO	0.15	335	0	220	0.15
SO_2	0.025	335	0	36.7	0.025
CO_2	195	335	0	286,000	195

* Uncontrolled rates provided by B&W, US EPA RBLC and US EPA AP-42

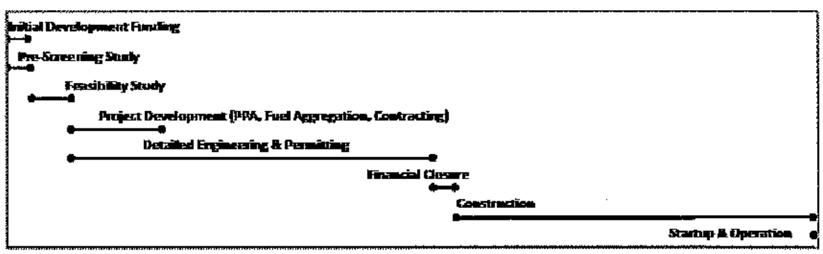
** PTE = Potential to Emit (emissions for 8760 hr/yr)

Wastewater Discharge
- 25 gpm boiler blowdown
- Cooling-water blowdown

Water Supply
- 25 gpm boiler-water makeup
- 215 gpm cooling-tower makeup

Project Schedule

Realistic Expectations = Achievable Plan



Typical biomass power projects will have a sequence of milestones as indicated in the timeline above:
- The overall timeline will vary depending upon project-specific circumstances, but two-three years is a reasonable outlook.
- Steps that depend on funding can be delayed by complexity.
- Construction can be hindered by weather.
- Environmental permitting is an often underestimated aspect that is getting increasing attention from the public. Allow 6-24 months for permitting.

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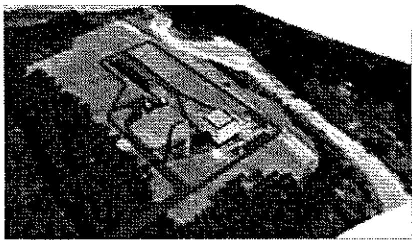


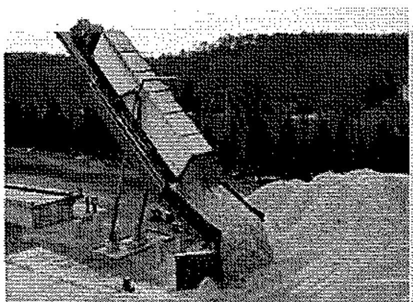
Summary Plant Description

The biomass plant is sized at 25MW using a bubbling fluid bed boiler and a condensing-steam turbine. Woody biomass is used as the primary fuel with approximately 40% moisture and a heating value of 5,160 BTU/lb.

Base Plant Equipment

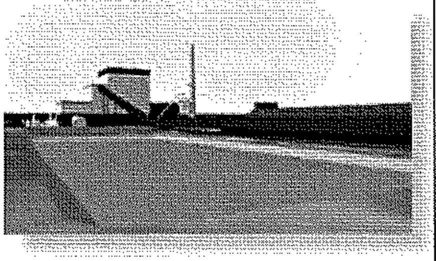
The base plant consists of the following major equipment and facilities:

- One single-drum bubbling fluid-bed power boiler with back-end emissions control equipment consisting of a baghouse and selective non-catalytic reduction (SNCR); boiler has an operating temperature and pressure of 950°F and 1,500 psig
- One single-casing, axial-exhaust, steam turbine with generator and associated accessories
- One natural gas fired auxiliary package boiler sized at 25,000 lb/hr.
- Two, 100-percent-capacity boiler feed pumps; one motor-driven and one steam-turbine-driven
- Separate deaerator and storage tank, one closed low pressure and two closed high pressure feed water heaters
- Two, 100-percent-capacity condensate feed pumps
- One, water-cooled condenser
- One, mechanical-draft cooling tower with 2x100% circulating water pumps
- One, biomass island (four-day supply) consisting of one truck scale, one truck dumper, one stacker, one reclaimer, and a processing area and boiler biomass feed conveyor
- Control room and administration area
- Water treatment area
- Transformers, circuit breakers and bus duct
- Plant maintenance and laydown areas
- Building enclosure for the boiler, steam turbine, water treatment, control, administration and wood processing areas



Our 25 MW reference plant would require approximately one truck per hour during operating hours or about 7,000 trucks per year of biomass fuel.

Operating Data and Specifications



Steam Production Rates and Properties

Steam Flow (pph)	Steam Pressure (psig)	Steam Temperature (Degrees F)	FW Temperature (Degrees F)	Net Plant Heat Input (MMBtu/hr)
250,000	1,500	950	480	335

Boiler Fuel Specification

H_2O (% Wt.)	Ash (% Wt.)	S (% Wt.)	H_2 (% Wt.)	C (% Wt.)	N_2 (% Wt.)	O_2 (% Wt.)	HHV (Btu/lb)	Annual Use (Tons)
40	1.2	0.07	3.24	32.3	0.6	22.7	5,160	212,210

Process Water Rates

Circulating Water Flow (gpm)	Make-Up Water Flow (gpm)	Cooling Tower Evaporation (gpm)	Boiler Blowdown (gpm)	Cooling Tower Blowdown (gpm)
15,000	292	217	25	50

Uncontrolled Air Emissions and Waste Generation Rates (Estimated)

PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	NOx (tpy)	CO (tpy)	SO_2 (tpy)	VOC (tpy)	Pb (tpy)	CO_2 (tpy)	Ash Generation (tpy)
150	148	147	293	220	37	73	0.15	286,000	3,300

Controlled Air Emissions (Estimated)

PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	NOx (tpy)	CO (tpy)	SO2 (tpy)	VOC (tpy)	Pb (tpy)	CO_2 (tpy)
22	18	44	147	220	37	73	0.15	286,000

Post Control Boiler Emission Factors (lb/MMBtu)

PM	PM_{10}	$PM_{2.5}$	NOx	CO	SO2	VOC	Pb
0.015	0.012	0.03	0.10	0.15	0.025	0.05	0.0001

Notes:

[1] Controlled and uncontrolled air emissions include fugitive emissions from a ten-acre biomass storage pile.
[2] NOx is controlled through the use of SNCR.
[3] PM, PM10, PM2.5 are controlled through the use of a fabric filter.

Low-value wood species can be chipped as part of a diversified biomass supply.

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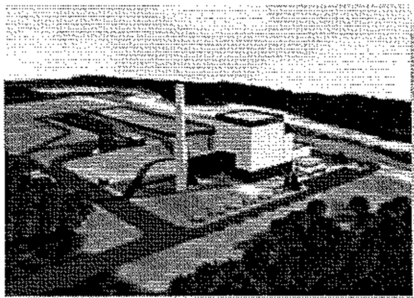


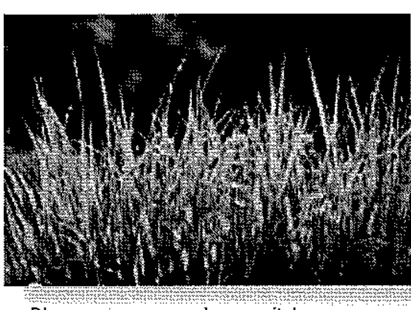
Potentially-Applicable Permitting Issues

Air Permitting

- **Prevention of Significant Deterioration (PSD):** Our 25-MW reference facility specified would require PSD permitting because uncontrolled NOx emissions are estimated to be 293 tons per year. A Best Available Control Technology (BACT) study would be required to determine the control equipment installed, and dispersion modeling would be required to comply with the increment of air quality deterioration allowed by the regulation. If a project locates in a PSD non-attainment area, the applicability thresholds are lower, more pollutants would be regulated and permitting would be more complex, with likely stricter emission limits and a requirement for emission offsets. Note that green house gas (primarily CO2) emission standards for new facilities are pending and may become part of the PSD applicability determination.
- **New Source Performance Standards (NSPS):** NSPS are set to regulate criteria pollutants from certain facilities and processes. NSPS Db is a federal regulation that sets standards for boilers with a heat input rating greater than 250 MMBtu/hr. Boiler air emissions will need to meet the NSPS standards if no other stricter limits are imposed on the facility (e.g., BACT limits).
- **New Emission Standards for Hazardous Air Pollutants (NESHAPS or MACT Standards):** NESHAPS are standards that set emission limits and determine the type of add-on controls needed for reducing a facility's hazardous air pollutant (HAP) emissions. Note that EPA is proposing new HAP standards for boilers in April 2010 which will likely aim to regulate all types of boilers and fuel.
- **State Specific Rules:** Industrial-air-emission regulations vary somewhat from state to state. Some states adopt and cite the federal regulations; others impose stricter rules to further control industrial site emissions. State rules should always be considered during the permitting process.

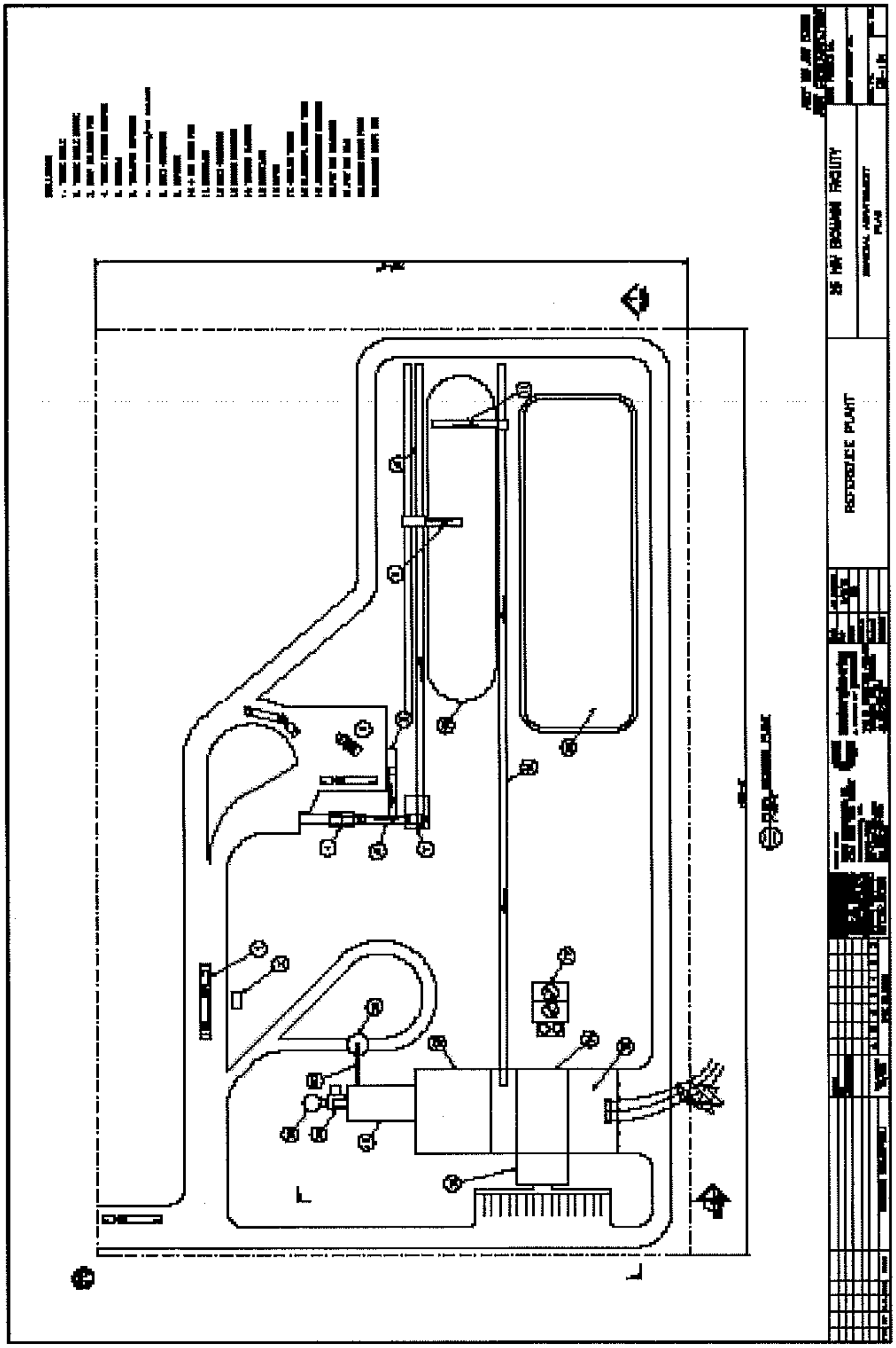
Water Permitting

- **National Pollutant Discharge Elimination System (NPDES):** The NPDES program controls water pollution by regulating point sources that discharge pollutants into the waters of the U.S. NPDES permits contain limits for pollutant discharges into water bodies. If a water body is classified as impaired and is regulated by a TMDL limit, it is possible that no increase in specific pollutants will be allowed, thereby significantly impacting the design or feasibility of a project.
- **Storm Water:** Stormwater discharges associated with construction and industrial activity require permits under the NPDES Stormwater Program. Facilities are required to develop a stormwater management program designed to prevent runoff from washing harmful pollutants into receiving water bodies or from being dumped directly into municipal stormwater systems.



Biomass crops, such as switchgrass, are an emerging option.

General Arrangement Plan



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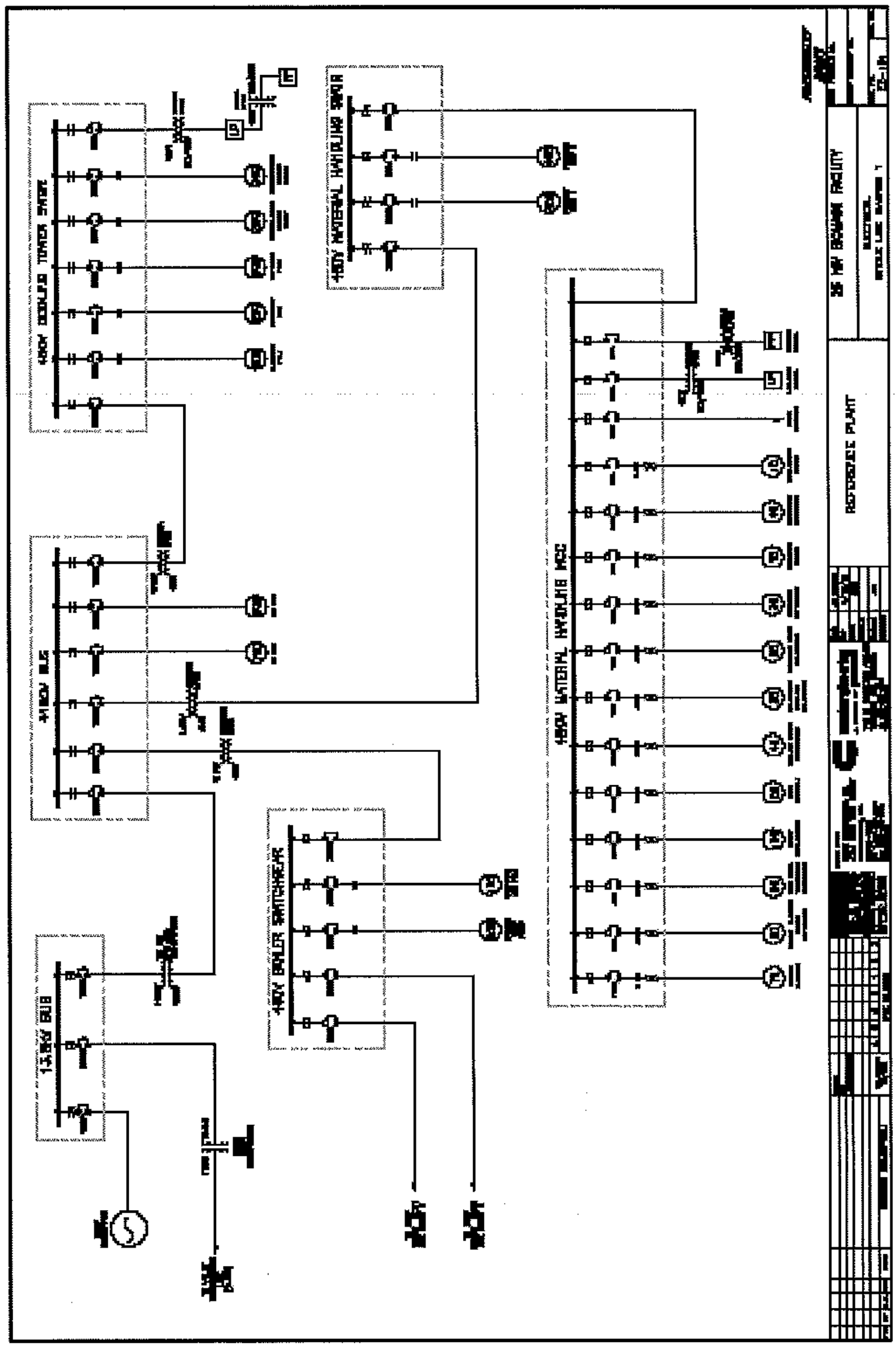
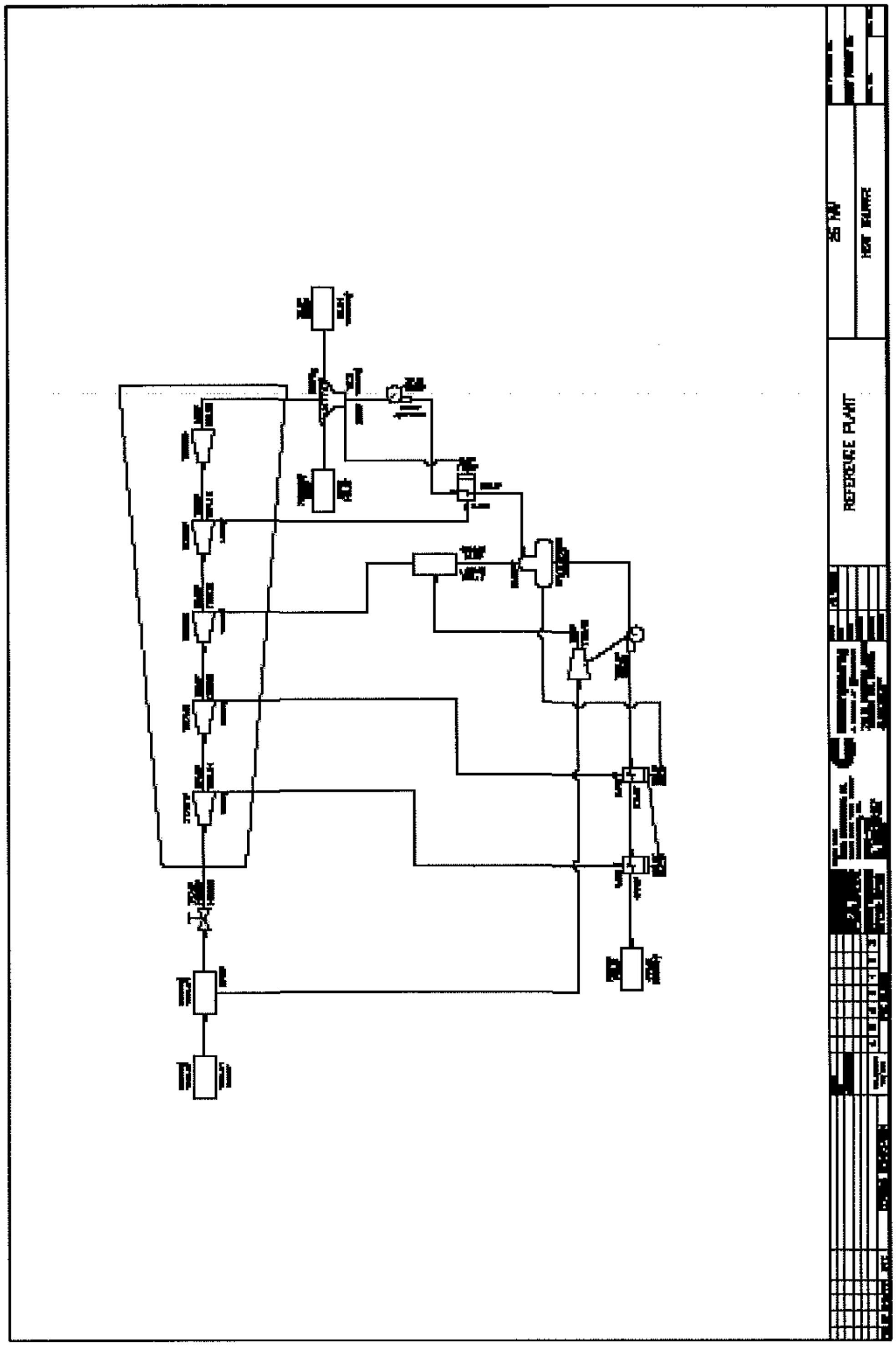
Electrical Single-Line Diagram

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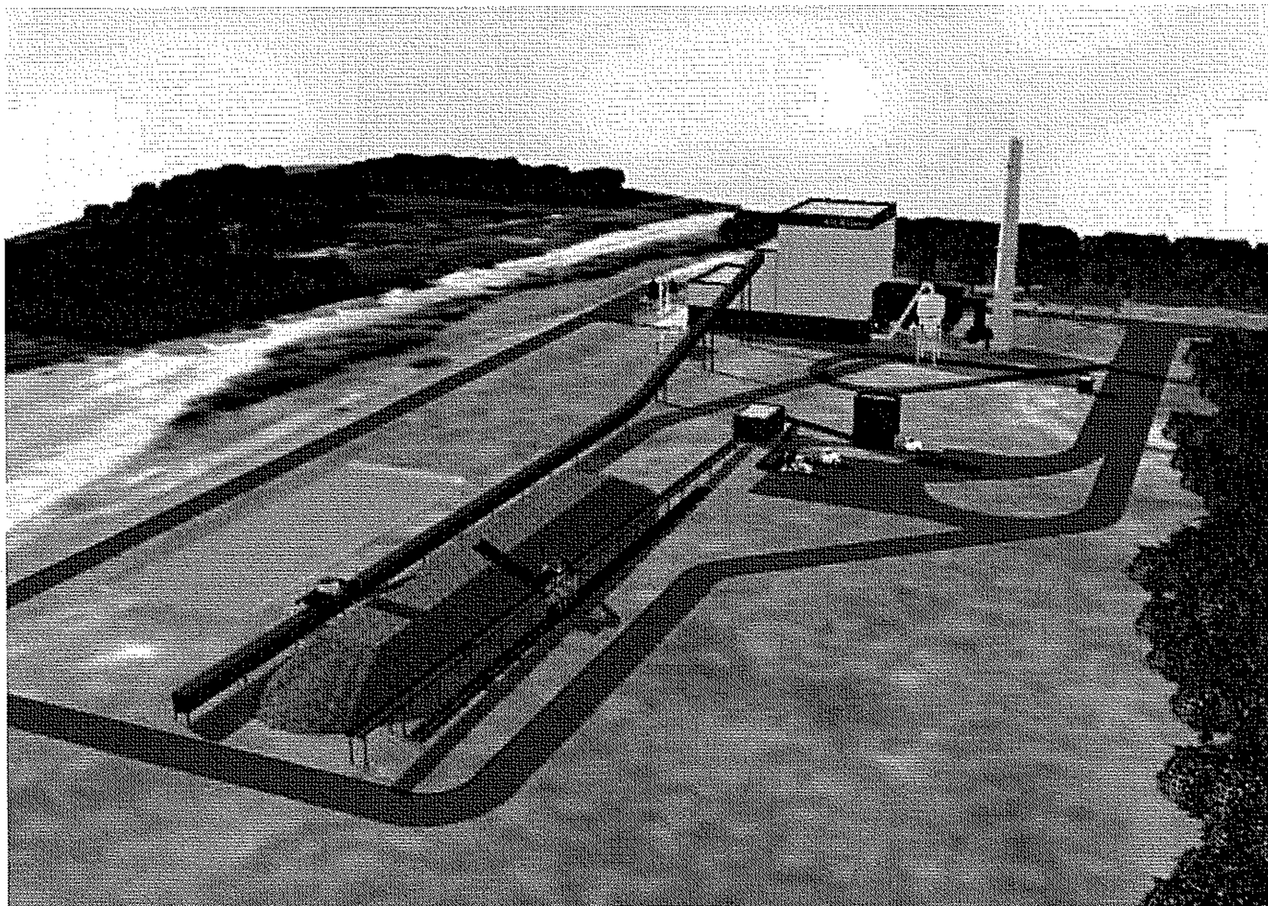

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