

**Reporting for**  
**Energy Modeling**  
**and**  
**Life Cycle Cost**  
**Analysis**

# Contact Information:

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# Submittal Information and Forms

The energy model and life cycle cost analysis shall be submitted at each phase as a stand-alone document.

This [document] shall not be bound with the soils report, cost estimate, comment responses, or other documentation.

# Submittal Information and Forms

The designer shall submit the following information with each project phase, starting with the schematic design.

# 1. Cover Sheet and fly sheet with the following information at a minimum:

Indicate this is an Energy Model and a Life Cycle Cost Analysis for “Agency Name” and “Project Name”.

Date of Report and Project Phase (SD,DD,CD)

SCO ID#

Code and Item

Project Location

Design Team

Seals and Signatures of Designers of Record

Optional:

(1) Design Team firm logos

(2) Agency Logos

Agency and Project name and SCO ID#

Energy Model  
and  
Life Cycle Cost Analysis  
for  
“Agency Name” and “Project Name”

Date of Report: October 17, 2008

Project Phase: Schematic Design/Design Development/Construction Document

SCO ID# 2008-01 2345-01A

Code: 40074 and Item: 353

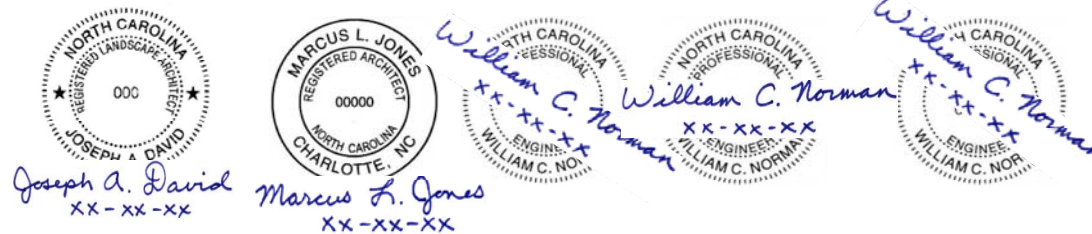
Project Location: Asheboro North Carolina

Design Team company names, addresses, telephone numbers and email addresses:

Rchitects Is Us in association with Ngineers R Us  
Route 3 Box 555  
Chalybeate Springs, NC 27543  
919-123-4567  
[info@rchitectsisus.com](mailto:info@rchitectsisus.com)

Provide company web address if available: [rchitectsisus.com](http://rchitectsisus.com)

Seals and Signatures of Designers of Record



Optional Design Team firm logos:



Optional Agency logo:

**NC STATE UNIVERSITY**

Date of report and sequential page numbers:

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Summary	

## Project Narrative

**Provide a Project Narrative: Discuss the project criteria, design recommendations and decision rationale, and the building elements that are modeled in the energy model, and how those elements are combined to create a composite building that is compliant with requirements of the Statute.**

Building Elements shall include at least two options for each of the following components:

- a. **Building Envelope:** The base case shall be labeled A-1, and the options shall be numbered A-2, A-3, etc.
- b. **Domestic Water Heating Systems:** The base case shall be labeled P-1 and the options shall be numbered P-2, P-3, etc.
- c. **HVAC systems and controls:**
  - (1) **Primary Systems:** The base case shall be labeled H1-1 and the options shall be numbered H1-2, H1-3, etc.
  - (2) **Secondary Systems:** The base case shall be labeled H2-1 and the energy strategies shall be numbered H2-2, H2-3, etc.
- d. **Lighting control and lighting design:** The base case shall be labeled E-1 and the energy strategies shall be numbered E-2, E-3, etc.
- e. **Additional strategies may be required to meet the energy efficiency requirements:** Use sequential numbering for additional strategies.
- f. **Name and version of the simulation program utilized to model the building energy use, as well as the life cycle cost analysis.**

GENERAL BUILDING ENERGY MODEL INFORMATION			
<b>Performance Rating Method Compliance Report</b>			
Project Name:		SCO ID #:	
Project Address:		Date:	
Designer of Record:		Telephone:	
Contact Person:		Telephone:	
City:		Principal Heating Source:	
		<input type="checkbox"/> Fossil Fuel <input type="checkbox"/> Electricity <input type="checkbox"/> Solar/Site Recovered <input type="checkbox"/> Other	
Weather Data:			
Climate Zone:			
<b>Space Summary</b>			
Building Use	Conditioned Area (sf)	Unconditioned (sf)	Total (sf)
1. Office (Open Plan)			
2. Office (Executive/Private)			
3. Corridor			
4. Lobby			
5. Restrooms			
6. Conference Rooms			
7. Mechanical/Electrical Room			
8. Copy Room			
9. Classrooms			
10. Laboratories			
11. Assembly Areas			
12. Dormitories			
13. Other:			
14. Other:			
15. Other:			
<b>Additional Building Information</b>			
Quantity of Floors			
Simulation Program			
Utility Rate: Electricity			
Utility Rate: Natural Gas			
Utility Rate: Steam or Hot Water			
Utility Rate: Chilled Water			
Utility Rate: Other			

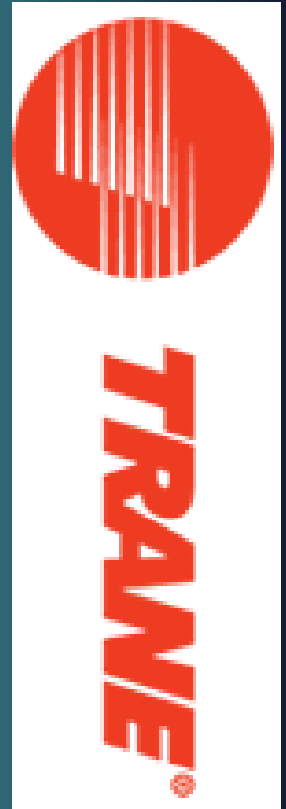


<b>BASELINE AND PROPOSED DESIGN INPUT PARAMETERS</b>			
<b>Performance Rating Method Compliance Report</b>			
<b>Comparison of Proposed Design versus Baseline Design Energy Inputs:</b>			
<b>Building Element</b>	<b>ASHRAE 90.1 Baseline Building Input Data</b>	<b>Proposed Design Building (1) Input Data</b>	<b>Proposed Design Building (2) Input Data</b>
<b>Envelope</b>			
Above Grade Wall Construction(1)			
Above Grade Wall Construction(2)			
Above Grade Wall Construction(3)			
Below Grade Wall Construction			
Roof Construction			
Exterior Floor Construction			
Slab-On-Grade Construction			
Window-to-Cross Wall Ratio			
Fenestration Type(s)			
Fenestration Assembly U-factor			
Fenestration Assembly SHGC			
Fenestration Visual Light Transmittance			
Fixed Shading Devices			
Automated Movable Shading Devices			
<b>Electrical Systems &amp; Process Loads</b>			
Ambient Lighting Power Density, and Lighting Design Description			
Process Lighting			
Lighting Occupant Sensor Controls			
Daylighting Controls			
Exterior Lighting Power (Tradable Surfaces)			
Exterior Lighting Power (Non-Tradable Surfaces)			
Receptacle Equipment			
Elevators or Escalators			
Refrigeration Equipment			
Other Process Loads			

<b>BASELINE AND PROPOSED DESIGN INPUT PARAMETERS (CONTINUED)</b>			
<b>Performance Rating Method Compliance Report</b>			
<b>Comparison of Proposed Design versus Baseline Design Energy Inputs:</b>			
<b>Building Element</b>	<b>ASHRAE 90.1 Baseline Building Input Data</b>	<b>Proposed Design Building (1) Input Data</b>	<b>Proposed Design Building (2) Input Data</b>
<b>Mechanical &amp; Plumbing Systems</b>			
HVAC System Type(s)			
Design Supply Air Temperature Differential			
Fan Control			
Fan Power			
Economizer Control			
Demand Control Ventilation			
Unitary Equipment Cooling Efficiency			
Unitary Equipment Heating Efficiency			
Chiller Type, Capacity, and Efficiency			
Cooling Tower			
Boiler Efficiency			
Chilled Water Loop and Pump Parameters			
Condenser Water Loop and Pump Parameters			
Hot Water Loop and Pump Parameters			
Service Hot Water System(s)			

ENERGY MODEL RESULTS: Percentage Improvement (Separate form needed for each proposed building model)						
Performance Rating Method Compliance Report						
Energy Summary by End Use						
End Use	ASHRAE 90.1 Baseline Building			Proposed Building #		
	Energy Type	Energy [10 Btu]	Peak [10 <sup>3</sup> Btu/h]	Energy [10 Btu]	Peak [10 <sup>3</sup> Btu/h]	Energy [%]
Interior Lighting (Ambient)						
Interior Lighting (Process)						
Exterior Lighting						
Space Heating (fuel 1)						
Space Heating (fuel 2)						
Space Cooling						
Pumps						
Heat Rejection						
Fans - Interior						
Fans - Parking Garage						
Service Water Heating (fuel 1)						
Service Water Heating (fuel 2)						
Receptacle Equipment						
Refrigeration (food, etc.)						
Cooking (commercial, fuel 1)						
Cooking (commercial, fuel 2)						
Elevators and Escalators						
Other Process						
<b>Total Building Consumption</b>						
<i>Note: Energy Consumption is listed in units of site energy</i>						
<i>10<sup>3</sup> Btu = kWh x 3.413    10<sup>3</sup> Btu = therms / 100</i>						
Type	Baseline Building		Proposed Building		% Improvement	
	Energy Use [10 Btu]	Energy Cost [\$ / yr]	Energy Use [10 Btu]	Energy Cost [\$ / yr]	Energy %	Cost %
<b>Energy Use (Regulated &amp; Unregulated)</b>						
Electricity						
Natural Gas						
Steam or Hot Water						
Chilled Water						
Other						
<b>Total Nonrenewable</b>						
<b>Regulated &amp; Unregulated</b>						
<b>Total:</b>						
Percentage Improvement = 100 x [1 - (proposed Building Performance / Baseline Building Performance)]						

# 5. Simulation Programs



Plane Trace



## 6. Compliance



**COMcheck-Web™**

## The report shall include simulation output or models for:

- One model for the baseline or code compliant building
- One or more models for a 20% or 30% more efficient composite building

# 7. LCCA

**Table 2-1**

**MINIMUM REQUIRED ALTERNATIVES FOR LIFE CYCLE COST ANALYSIS**

PROJECT _____ ID NO. _____		
Component	Alternatives to Analyzed	Y/N
Pre-design	Maintain status quo (do nothing)	
	New acquisition or construction	
	Leasing	
	Renovation, upgrade, or revitalization of an existing facility	
	Use of other State facilities	
Site and Program	Building shape and orientation on the planned site (including impact on adjacent buildings)	
	Alternative site(s)	
Architecture	Substructure <ul style="list-style-type: none"> <li><input type="checkbox"/> Foundations</li> <li><input type="checkbox"/> Slab on grade</li> <li><input type="checkbox"/> Basement excavation</li> <li><input type="checkbox"/> Basement and retaining walls</li> <li><input type="checkbox"/></li> </ul>	
	Superstructure <ul style="list-style-type: none"> <li><input type="checkbox"/> Floor construction</li> <li><input type="checkbox"/> Roof construction</li> <li><input type="checkbox"/> Stair construction</li> <li><input type="checkbox"/></li> </ul>	
	Wall construction <ul style="list-style-type: none"> <li><input type="checkbox"/> Increased insulation levels, insulation placement, etc.</li> <li><input type="checkbox"/> Mass (passive solar thermal storage)</li> <li><input type="checkbox"/> Daylighting</li> <li><input type="checkbox"/> Building envelope (exterior closure) type</li> <li><input type="checkbox"/></li> </ul>	
	Fenestration <ul style="list-style-type: none"> <li><input type="checkbox"/> Type, amount, and location/orientation of glass</li> <li><input type="checkbox"/> Indoor/outdoor shading devices</li> <li><input type="checkbox"/> Daylighting</li> <li><input type="checkbox"/></li> </ul>	
	Interior space plan <ul style="list-style-type: none"> <li><input type="checkbox"/> Space arrangement</li> <li><input type="checkbox"/> Circulation</li> <li><input type="checkbox"/> Finishes and colors</li> <li><input type="checkbox"/> Ceiling heights</li> <li><input type="checkbox"/></li> </ul>	
	Roof construction <ul style="list-style-type: none"> <li><input type="checkbox"/> Increased insulation levels, type of insulation</li> <li><input type="checkbox"/> Roof membrane type and color</li> <li><input type="checkbox"/> Daylighting</li> <li><input type="checkbox"/></li> </ul>	

Agency and Project name and SCO ID#

	Conveyances <input type="checkbox"/> Selection of elevators and dumbwaiters <input type="checkbox"/> Escalators <input type="checkbox"/>	
HVAC	Secondary HVAC system(s) <input type="checkbox"/> System(s) type(s) and zoning <input type="checkbox"/> Economizer cycle(s) <input type="checkbox"/> Heat recovery (exhaust air, internal source, etc.) <input type="checkbox"/>	
	Primary HVAC system(s) <input type="checkbox"/> System(s) type(s) and energy sources <input type="checkbox"/> Pumping/piping configuration <input type="checkbox"/> Heat recovery, waterside economizer cycle, etc. <input type="checkbox"/> Thermal storage (electrical demand shifting) <input type="checkbox"/>	
Plumbing	Plumbing system(s) <input type="checkbox"/> Domestic hot water generation (method and energy source) <input type="checkbox"/>	
Electrical	Lighting <input type="checkbox"/> Artificial lighting levels, methods, and control, including general lighting and task lighting. <input type="checkbox"/> Daylighting <input type="checkbox"/>	
	Power <input type="checkbox"/> Voltage selection (building and large equipment) <input type="checkbox"/> Transformers (quantity, locations, efficiencies) <input type="checkbox"/>	

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**Building Envelope**

- Baseline A-1
- Option A-2
- Option A-3

**Domestic Water Heating Systems**

- Baseline P-1
- Option P-2
- Option P-3

**HVAC systems and controls**

**Primary Systems**

- Baseline H1-1
- Option H1-2
- Option H1-3

**Secondary Systems**

- Baseline H2-1
- Option H2-2
- Option H2-3

**Lighting control and lighting design**


- Baseline E-1
- Option E-2
- Option E-3


**Additional strategies**

- Option X-1 Photovoltaic
- Option X-2 Wind Turbine
- Option X-3 Solar Water Heater
- Option X-4 Solar Preheat

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LIFE CYCLE COST ANALYSIS FOR STATE FACILITIES		 STATE CONSTRUCTION OFFICE N.C. DEPT. OF ADMINISTRATION RALEIGH, NORTH CAROLINA	
<b>GENERAL DATA</b>			
PROJECT NAME			
PROJECT ID			
AGENCY			
<b>DESIGN ALTERNATIVE</b>			
ID NUMBER			
TITLE			
DESCRIPTION			
<b>ANALYSIS PERFORMED BY</b>			
NAME			
DATE			

<b>LIFE CYCLE COST ANALYSIS</b>				STATE CONSTRUCTION OFFICE	
<b>FOR STATE FACILITIES</b>				N.C. DEPT. OF ADMINISTRATION	
				RALEIGH, NORTH CAROLINA	
	DATA FOR ALTERNATIVE NO.	A-1, P-1, H1-1, H2-1, P-1, X-1, etc.			
	CONSTRUCTION YEAR				
	ECONOMIC LIFE		Years		
	INFLATION RATE	2.7	%		
<b>CAPITAL INVESTMENT</b>					
	CAPITAL		\$		
	LOAN/BOND		%		
	INTEREST RATE		%		
	LOAN/BOND TERM		Years		
<b>ANNUAL OPERATING COSTS AND CONSUMPTION</b>					
	ELECTRICITY		\$		KWH
	NATURAL GAS		\$		MCF
	PROPANE		\$		GAL
	FUEL OIL		\$		GAL
	COAL		\$		TONS
	MAINTENANCE		\$		
<b>NON-RECURRING REPAIR/REPLACEMENT COSTS</b>					
	DESCRIPTION	YEAR	COST	\$	
				\$	
				\$	
				\$	
				\$	
				\$	

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LIFE CYCLE COST ANALYSIS FOR STATE FACILITIES				STATE CONSTRUCTION OFFICE	
				N.C. DEPT. OF ADMINISTRATION	
				RALEIGH, NORTH CAROLINA	
YEAR	CAPITAL \$	ENERGY \$	MAINTENANCE \$	REPAIR/REPLACE \$	TOTAL COST
1	\$0	\$0	\$0	\$0	\$0
2	\$0	\$0	\$0	\$0	\$0
3	\$0	\$0	\$0	\$0	\$0
4	\$0	\$0	\$0	\$0	\$0
5	\$0	\$0	\$0	\$0	\$0
6	\$0	\$0	\$0	\$0	\$0
7	\$0	\$0	\$0	\$0	\$0
8	\$0	\$0	\$0	\$0	\$0
9	\$0	\$0	\$0	\$0	\$0
10	\$0	\$0	\$0	\$0	\$0
11	\$0	\$0	\$0	\$0	\$0
12	\$0	\$0	\$0	\$0	\$0
13	\$0	\$0	\$0	\$0	\$0
14	\$0	\$0	\$0	\$0	\$0
15	\$0	\$0	\$0	\$0	\$0
16	\$0	\$0	\$0	\$0	\$0
17	\$0	\$0	\$0	\$0	\$0
18	\$0	\$0	\$0	\$0	\$0
19	\$0	\$0	\$0	\$0	\$0
20	\$0	\$0	\$0	\$0	\$0
21	\$0	\$0	\$0	\$0	\$0
22	\$0	\$0	\$0	\$0	\$0
23	\$0	\$0	\$0	\$0	\$0
24	\$0	\$0	\$0	\$0	\$0
25	\$0	\$0	\$0	\$0	\$0
26	\$0	\$0	\$0	\$0	\$0
27	\$0	\$0	\$0	\$0	\$0
28	\$0	\$0	\$0	\$0	\$0
29	\$0	\$0	\$0	\$0	\$0
TOT.	\$0	\$0	\$0	\$0	\$0
<b>TOTAL LIFE CYCLE COST FOR ALTERNATIVE NO.</b>					\$0

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## Summary

**Provide a summary of the selected design approach for the proposed facility.**

# Submittal Information and Forms

The energy model information and the life cycle cost analysis shall be submitted at each phase as a stand-alone document. This should not be bound with the soils report, cost estimate, comment responses, or other documentation items.

Designer shall submit the following information at each project submittal, starting at the schematic design phase:

1. Cover Sheet and fly sheet with the following information at a minimum:
  - Indicate this is an Energy Model and a Life Cycle Cost Analysis for "Agency Name" and "Project Name".
  - Date of Report and Project Phase (SD,DD,CD)
  - SCO ID#
  - Code and Item
  - Project Location
  - Design Team company names, addresses, telephone numbers and email addresses. Provide company web address if available.
  - Seals and Signatures of Designers of Record
  - Optional:
    - (1) Design Team firm logos
    - (2) Agency Logos
2. Table of Contents
3. Narrative: Discuss the project criteria, design recommendations and decision rationale, and the building elements that are modeled in the energy model, and how those elements are combined to create a composite building that is compliant with requirements of the Statute. Building Elements shall include at least two options for each of the following components:
  - a. Building Envelope: The base case shall be labeled A-1, and the options shall be numbered A-2, A-3, etc.
  - b. Domestic Water Heating Systems: The base case shall be labeled P-1 and the options shall be numbered P-2, P-3, etc.
  - c. HVAC systems and controls:
    - (1) Primary Systems: The base case shall be labeled H1-1 and the options shall be numbered H1-2, H1-3, etc.
    - (2) Secondary Systems: The base case shall be labeled H2-1 and the energy strategies shall be numbered H2-2, H2-3, etc.
  - d. Lighting control and lighting design: The base case shall be labeled E-1 and the energy strategies shall be numbered E-2, E-3, etc.
  - e. Additional strategies may be required to meet the energy efficiency requirements: Use sequential numbering for additional strategies.
  - f. Name and version of the simulation program utilized to model the building energy use, as well as the life cycle cost analysis.
4. Complete the calculation forms located at the end of this Section.
5. Software reports indicating base building compliance with ASHRAE 90.1-2004.
6. Software reports for all strategies indicating compliance with the requirements of the Statute.
7. Life Cycle Cost Analysis for base ASHRAE Standard 90.1-2004 compliant building and the two or more alternate buildings with varying strategies resulting in required energy savings:
  - a. Include and use Table 2-1 from the LCCA manual.
  - b. Use the same numbering system noted above for the design alternatives.
  - c. Provide a "General Data" sheet for each building with all alternate energy strategies.
  - d. Provide a "Baseline And Proposed Design Input Parameters" sheet for each alternate building.
  - e. Provide a LCCA spreadsheet for each alternate system.
  - f. Provide a SIR (Savings-to-Investment) Analysis for the base case and alternate building designs.
8. Provide Summary of the selected design approach.

# Contact Information:

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