2013

Power Plant System Engineering Analysis

EE 565

FANA TEFFERA

Contents

ELECTRICTY FOR FORT DODGE

BACKGROUND

Fort Dodge is a city and county seat of Webster County in Iowa along the Des Moines River. It is located on US Routes 20 and 169. The city began in 1850.

The population of Fort Dodge stands at approximately 25,000 currently.

The major industries of Fort Dodge are gypsum and limestone mining, drywall manufacturing, trucking, the manufacture of veterinary pharmaceuticals and vaccines, and retail. The gypsum drywall industry is served by (3) major national trucking companies.

For most of the 20th century, meat processing and packing was a major industry in Fort Dodge. But the meat processing and packing plants closed. One of the laboratories for the manufacture of veterinary pharmaceuticals and vaccines was built on the site of a former meat processing and packing plant.

Fort Dodge has been plodding along over the past few decades, but has not experienced significant growth, and the city lost its former vigor and luster, and some buildings and areas became drab and dilapidated. However, the Fort Dodge correctional Facility, 1,250bed medium security state prison was opened in 1998. Then in 1999 Fort Dodge enlarged its waste water treatment plant, and made major improvements to it.

Moreover since the end of 2005 a number of companies built bio-refinery plants in the Fort Dodge area. The bio-refinery plants mill and grind corn, and extract ethanol from the corn through its fermentation with yeast. The distiller grain left over after the ethanol is removed from the corn is sold as livestock feed.

DETERMINATION OF NEEDS AND PROBLEMS

1. City has embarked on a program to revitalize itself and grow
2. Need to replace the city's decayed electric system and grid, and make the new system and grid bigger
3. High cost of electricity from existing providers
4. Embarked on a goal to produce the required electricity locally from 'clean' source/s, to optimize its supply, and minimize its consumption
5. Large Volume/Mass of waste. Need to do something with it. Keep the city and its surrounding area pollution free
6. Electricity generation and waste disposal facilities are to be safe
7. Project study and design to take no more than (2 years), and construction no more than (3) years. Project to be completed and implemented by end October 31, 2018
8. Development project is to be managed by city, but financed by city and private stakeholders
9. Maximum cost of the project: $57 million dollars.

Fort Dodge has hired our firm 'Paragon Energy Concepts Ltd' to be the Systems Engineer for the electrical energy generation and waste management part of their city development project.

DESCRIPTION OF CURRENT SYSTEM

Majority of the electrical energy consumed in Fort Dodge comes from coal plants. Some electrical energy comes from the Nuclear Duane Arnold Energy center in Palo. Wind energy is also utilized. Energy from bio-fuels is applied increasingly. The electrical energy is supplied to Fort Dodge with the American interstate electricity transmission grid.

STAKEHOLDERS

- Fort Dodge government and people
- Residential, commercial, and institutional users
- Industries and workforce

- Energy supply companies
- American legislative bodies
- Federal and State standards bureaus

MANAGEMENT AND FINANCING

City development project is to be managed by Fort Dodge, but financed by city and private stakeholders. Fort Dodge wants to revitalize itself, grow, and improve the quality of life for its citizens. Private stakeholders want to gain financially from the project.

IOWA ENERGY CONSUMPTION

Iowa per capita energy consumption in 2010: 489 million BTU (143. MWh)

US per capita energy consumption in 2010: 363 million BTU (106.3 MWh) Rank: 5

Fort Dodge population: 25,000

With 15% growth energy required: 14.1 trillion BTU (41.2GWh) per year

Iowa energy consumption by end-use sector, 2011:

Residential: 16.3%, commercial: 13.7%, industrial: 49.3%, transportation: 20.7%

AVAILABLE ENERGY RESOURCES

- Coal
- Natural gas
- Motor gasoline excl. ethanol
- Distilled fuel oil
- Liquefied petroleum gas

- Nuclear electric power
- Hydroelectric power
- Biomass
- Other renewable

United States has decided not to build more nuclear plants currently. Coal plants produce carbon dioxide and nitrogen oxide emissions. The emissions cause smog, acid rain, and toxic air pollution. United States has imposed a moratorium on the building of new coal plants. There are few hydroelectric power plants in the Iowa region and not much hydroelectricity is available. Wind towers are visually obtrusive to their surroundings and alone won't provide the electricity required, and there isn't enough intense sunshine in Iowa to provide solar energy. Natural gas, motor gasoline, distilled fuel oil, ethanol from biomass, and garbage wastes are well available in Fort Dodge as fuel for electricity production.

ADMINISTRATION

The consulting firm should weekly update the progress and get full cooperation from the stakeholders to gather feedback on the design-in-progress.

BUDGET

The study for the project and the design of the project will cost $7 million. The construction of the project will cost $57 million.

TIMELINE

The study for the project and the design of the project will be completed by Dec 15, 2015. The construction and deployment of the project will be completed by September 13 2018.

STATEMENT OF WORK

PROBLEM STATEMENT/GOAL

Our design shall provide a means of providing a well-researched and organized set of project set that can be used by the engineers to design additional source of electricity to the city of Fort Dodge. The final submission from our firm shall fully answer questions that may arise during the early stage of technical design of the plant.

DELIVERABLE

1 Paragon Energy will deliver Report of Analysis Study. This covers the system requirements.

1. Paragon Energy will deliver Development Report of the power plant. This will focuses the Data migration which focus on the measurement and collection of data.
2. Paragon Energy will deliver Testing and Training Report. This focus on the mock testing and the end user testing on the model that is presented. Such testing use the data gathering protocol that will be developed earlier.
3. Paragon Energy will deliver Documentation Report of the Finalized Review and Acceptance, end user training documentation and recorded change in the system.
4. Paragon Energy will deliver Construction Report, which will detail the planed route of constructing the facility.
5. Paragon Energy will deliver Reports on the Performance of the system once it goes online.
6. Paragon Energy will deliver Reports on the Power Plant Decommissioning. This will include the removal of hazardous materials, building demolition and complete documentation of plant closure.

SUMMARY OF TASKS

1. Paragon Energy will provide engineering analysis services describing the system requirement. The engineering services will include at a minimum: Identifying the process, preparing design and prototype, preparing detail technical requirements, reviewing hardware and software that will be used in the system.
2. Paragon Energy will provide Development analysis services which focus on data migration. This will include at a minimum Identifying data requirement, Collecting Planning data, Input and Upload Data, verifying data for the planning, result and schedule.
3. Paragon Energy will develop training and testing packages which can be used for mock testing and user end testing. This will cover mock testing, verifying plan, result, schedule and cost. This will also include Performing unit test, integration test, and monitoring and controlling scope cost.
4. Paragon Energy will perform documentation analysis to document final review and acceptance records, user training records and records of system change. This include process licensing and permit, Report in environmental impacts final design/drawing, final cost estimate and procurement.
5. Paragon Energy will perform theoretical analysis of construction process which include at a minimum site selection and preparation, structure erection and commissioning.
6. Paragon Energy will perform plants early start technical support and verification after it went online. Paragon Energy will perform analysis of decommissioning process. This will cover at minimum the removal of hazardous materials, building demolition and complete documentation of plant closure. This will be kept updated periodically while the system is running.

REQUIREMENTS

1. The system shall have a minimum of average operating capacity factor of 80%.
2. The system shall have a minimum power plant efficiency of 65%.
3. The system shall have a minimum of 25 MW output.
4. The system design should incorporate recycling the waste products.
5. The plant should have a minimum of 30 years plant life.
6. The plant should have less than 2 years of construction time.
7. The construction of the project should cost less than $57 million.
8. The cost for the overall design of the project should be less than $7 million.
9. The power plant shall adhere to the Iowa Code 455B.
10. The fuel used in the system shall adhere to the Iowa Code 455B.131.
11. All utilities that are used in the power plant shall adhere to the Federal Power Act of Pub. L. No. 95-617.
12. All utilities that are used in the power plant shall adhere to the Energy Policy Act of Pub. L. No. 102-486.
13. The power plant shall be able to operate 7 days a week for 24 hours each.
14. The power plant should be able to store heat to be used on demand.
15. The output amount for electricity should be synched with the demand base.
16. The production of electricity should be regulated to avoid power surge.
17. The power plant should include at least one tie breaker in the design.
18. The steady-state frequency deviation will be agreed up on before the start of the project.
19. Voltage deviation will be agreed up on before the start of the project.
20. The system design will integrate documented work place inspections program.
21. The power plant will shall include the frequency of the maintenance.
22. The power plant system designer will include operating instruction.
23. The power plan should be equipped with equipment that are able to give real time data of the operation.

24. The design should include the frequency of the periodical verification of the system.

25. All documents that are associated with the system will be signed by professional engineer.

26. All tests that are associated with the system will be signed by professional engineer.

REQUIRMENT ANALYSIS

(See Appendix)

REQUIREMENT TRACEABILITY MATRIX

Number	Name	Description	Refined by	Refines	KPP	Rationale	Owner	Test	Origin
1	Legal Requirement	This is rather sensitive to the current technology innovation that needed to be revised before the final draft of the process design.	Requirement 1.1 Iowa Legal Code Requirement 1.2 Federal Power Act Requirement 1.3 Energy Policy Act		FALSE	This is rather sensitive to the current technology innovation that needed to be revised before the final draft of the process design.	Client	Inspection	Originating
1.1	Iowa Legal Code	The power plant shall adhere to the Iowa Code 455B.		Requirement 1 Legal Requirement	FALSE	These are the legal code which the system should adhere to as a default guide lines. Considering the consequences, any	Client	Inspection	Originating

						trespassing of this code is not acceptable.			
1.2	Federal Power Act	All utilities that are used in the power plant shall adhere to the Federal Power Act of Pub. L. No. 95-617.		Requirement 1 Legal Requirement	FALSE	This law should have to be respect at all time, so that the execution phase will go on without no serious legal hurdles.	Client	Inspection	Originating
1.3	Energy Policy Act	All utilities that are used in the power plant shall adhere to the Energy Policy Act of Pub. L. No. 102-486.		Requirement 1 Legal Requirement	FALSE		Client	Inspection	Originating
2	Inputs Requirement		Requirement 2.1 Energy Source		FALSE		Client		Originating

2.1	Energy Source	The fuel used in the system should adhere to the Iowa Code 455B.131.		Requirement 2 Inputs Requirement	FALSE	This code include the necessary safety and other factors that needed to be added in the consideration of type of fuel to be used as in input.	Client	Inspection	Originating
3	Heat Requirement		Requirement 3.1 Heat Storage		TRUE		Client		Originating
3.1	Heat Storage	The power plant should be able to store heat to be used on demand.		Requirement 3 Heat Requirement	TRUE	Heat storage is useful in this system because not all heat that is produced will be collected will be used. By storing the heat, it will be possible to release is based on the demand. Every time electricity is produced, the heat will be also generated. The electricity production can be controlled by manipulating the	Client	Analysis	Originating

						input rate using the input control. Since the heat is needed for the treatment of the waste materials, as described in the background of the report, this function is necessary to fulfill the customer demand.			
4	Electricity Requirement		Requirement 4.1 Electricity Demand Requirement 4.2 Power Output Requirement 4.3 Power Surge Requirement 4.4 Steady State Frequency Requirement		TRUE		Client		Originating

			4.5 Tie Breaker Design Requirement 4.6 Voltage Deviation						
4.1	Electricity Demand	The output amount for electricity should be synched with the demand base.		Requirement 4 Electricity Requirement	TRUE	This system will allow us to generate the electricity when it is needed only. Since the peak time of electric usage and demand are reasonably predictable, it is possible to manage the production using the collected usage data too. This will help to avoid costly and wasteful production of electricity and heat. This will decrease the cost of heat storage as well.	System Engineer	Instrumented	Derived

4.2	Power Output	The system shall have a minimum of 25 MW output.		Requirement 4 Electricity Requirement	TRUE	This is based on the population of Fort Dodge and the amount of electricity demand by the residents and the industry. The production can be extended well above 25MW if the is a means of producing it with a significant low cost. This is assuming the energy need will have a linear growth.	Client	Analysis	Originating
4.3	Power Surge	The production of electricity should be regulated to avoid power surge.		Requirement 4 Electricity Requirement	TRUE	Considering the possibility in process control of the system, such function need to be introduced to the overall design to avoid sudden increase of electricity. Sudden increase of the	System Engineer	Analysis	Derived

						electricity can be a serious liability if not avoided. Consumer electronics can be damaged and it might lead to even higher industrial, environment or health related risks.			
4.4	Steady State Frequency	The steady-state frequency deviation will be agreed up on before the start of the project.		Requirement 4 Electricity Requirement	FALSE	This is rather sensitive to the current technology innovation that needed to be revised before the final draft of the process design.	System Engineer	Instrumented	Derived
4.5	Tie Breaker Design	The power plant should include at least one tie breaker in the design.		Requirement 4 Electricity Requirement	FALSE	Tie breakers are vacuum breakers that have a kirk key interlock system in place to ensure that the ties and both mains are never all closed at once putting transformers in	System Engineer	Instrumented	Derived

						parallel. This is designed so that transitions between transformers will affect the overall generation.			
4.6	Voltage Deviation	Voltage deviation will be agreed up on before the start of the project.		Requirement 4 Electricity Requirement	FALSE	This is rather sensitive to the current technology innovation that needed to be revised before the final draft of the process design.	System Engineer	Instrumented	Derived
5	Construction Requirement		Requirement 5.1 Construction Time		FALSE		Client		Originating
5.1	Construction Time	The plant should have less than 2 years of construction time.		Requirement 5 Construction Requirement	FALSE	This assumes that the supply and price of raw materials for construction will stay closer to the current value in the coming two years after the construction started.	Client	Analysis	Originating

6	Design Certification Requirement		Requirement 6.1 Document Certification Requirement 6.2 Test Certification		FALSE		Client		Originating
6.1	Document Certification	All documents that are associated with the system will be signed by professional engineer.		Requirement 6 Design Certification Requirement	FALSE	This is an originating requirement that are not negotiable.	Client	Inspection	Originating
6.2	Test Certification	All tests that are associated with the system will be signed by professional engineer.		Requirement 6 Design Certification Requirement	FALSE	This is an originating requirement that are not negotiable.	Client	Inspection	Originating
7	Safety Requirement		Requirement 7.1 Maintenance		FALSE		System Engineer		Derived

			Frequency Requirement 7.2 Work Place Inspections						
7.1	Maintenance Frequency	The power plant will shall include the frequency of the maintenance.		Requirement 7 Safety Requirement	FALSE	Maintenance schedule will increase the life time, stability, and customer confidence of the plant.	System Engineer	Analysis	Derived
7.2	Work Place Inspections	The system design will integrate documented work place safety inspections program.		Requirement 7 Safety Requirement	FALSE	Safety inspection of the labor and the skilled workers will be included in this report. This will also assist in meeting the legal demands.	System Engineer	Inspection	Derived
8	Performance Requirement		Requirement 8.1 Operating Capacity Requirement 8.2 Operating		TRUE		Client		Originating

			Efficiency Requirement 8.3 Operating Time Requirement 8.4 Operation Instruction Requirement 8.5 Real Time Data Requirement 8.6 Verification						
8.1	Operating Capacity	The system shall have a minimum of average operating capacity factor of 80%.		Requirement 8 Performance Requirement	TRUE	The 80% is the originating requirements which is given to Paragon by the client. This requirement is a reasonable expectation considering advances in technology.	Client	Analysis	Originating

8.2	Operating Efficiency	The system shall have a minimum power plant efficiency of 65%.		Requirement 8 Performance Requirement	TRUE		Client	Analysis	Originating
8.3	Operating Time	The power plant shall be able to operate 7 days a week for 24 hours each.		Requirement 8 Performance Requirement	TRUE	This is a necessary part of the plant performance considering the demand. It is expected that there is always a demand of electricity, even if it might vary in time, due to the industrial and consumer diversity.	Client	Demonstration	Originating
8.4	Operation Instruction	The power plant system designer will include operating instruction.		Requirement 8 Performance Requirement	TRUE		Client	Inspection	Originating

8.5	Real Time Data	The power plan should be equipped with equipment that are able to give real time data of the operation.		Requirement 8 Performance Requirement	TRUE	This will greatly enhance the control of the system.	System Engineer	Demonstrated	Derived
8.6	Verification	The design should include the frequency of the periodical verification of the system.		Requirement 8 Performance Requirement	TRUE	Verification of the system should be done periodically and the frequency will be asses with the cost and overall design in mind.	Client	Inspection	Originating
9	Recycling Requirement	The system design should incorporate recycling system for the output.			TRUE	This is assuming the input will produce a waster product as a part of the output.	System Engineer	Analysis	Derived
10	Schedual Requriement	The plant should have a minimum of			TRUE	This is based on the cost of the plant, the average age of the plant and the profit	Client	Analysis	Originating

		30 years plant life.				that is expected to be collected. There is an assumption that the change of technology will not be significant to the point that will make the plant unprofitable before the scheduled life time.			
11	Cost Requirement		Requirement 11.1 Construction Cost Requirement 11.2 Design Cost		TRUE		Client		Originating
11.1	Construction Cost	The construction of the project should cost less than $57 million.		Requirement 11 Cost Requirement	TRUE	This is the construction budget that is given to the Paragon Energy by the client. Paragon Engery accepted this design based on the early agreement that it will design the	Client	Demonstration	Originating

						system with the strict physical construction budget in mind. It is obvious that there are other type of cost that will be introduced as the design progress and once execution started.				
11.2	Design Cost	The cost for the overall design of the project should be less than $7 million.		Requirement 11 Cost Requirement	TRUE	This is the amount that is going to be paid for the study and the design of the project.	Client	Demonstration	Originating	

FUNCTIONAL ANALYSIS

(See Appendix)

FUNCTIONAL ANALYSIS TABLE

Number	Name	Description	based on		Input	Output
1	Mission Functions	The unrecyclable waste products will be removed.				
1.1	To Input the Fuel	The system will take the chosen fuel into the system.	Requirement 2.1 Energy Source			
1.2	To Control the Input	The input must be controlled to avoid contaminating the generator with contaminants or damaging it with high flow rate.	Requirement 1.2 Federal Power Act Requirement 1.3 Energy Policy Act Requirement 2.1 Energy Source			
1.2.1	To Control Quality of Input	This will control the contaminant rate in the fuel/fluid and pass only that is above the minimum expectation.	Requirement 2.1 Energy Source			Item Recycled Fluid Generation
1.2.1.1	To Feed High Quality	Only high quality input will be fed to the system. This function feeds high quality feeds.	Requirement 2.1 Energy Source			
1.2.1.2	To Remove Low Quality Input	Unrecyclable waste is extracted as final waste product out of the system.	Requirement 2.1 Energy Source			
1.2.2	To Control Rate of Input	This will control the rate of the fluid coming in to avoid any potential damage to the system or unexpected surge of power production.	Requirement 4 Electricity Requirement			
1.3	To Generate Energy	This will generate heat and electricity	Requirement 1.1 Iowa Legal Code Requirement 1.2 Federal Power Act Requirement 1.3 Energy Policy Act Requirement 3 Heat Requirement Requirement 4 Electricity Requirement			

1.3.1	To Generate Electricity	The system will generate electricity using the selected fuel as an energy source.	Requirement 2 Inputs Requirement Requirement 6 Design Certification Requirement			Item Electricity Demand Feedback
1.3.2	To Collect Heat	The system generate heat using the power plant.	Requirement 3 Heat Requirement			
1.4	To Recycle The Waste	The waste product from the generation will be recycled.	Requirement 9 Recycling Requirement			
1.4.1	To Separate Waste	This function allow the system to separate the fuel that can be used again as an input.	Requirement 9 Recycling Requirement			
1.4.1.1	To Feed Recycled Input	The recycled waste from generation will be fed to the input control system for furthure check and it will be fed to generation if it pass.	Requirement 2 Inputs Requirement Requirement 9 Recycling Requirement			Item Recycled Fluid Generation
1.4.1.2	To Remove Unrecyclable	The unrecyclable waste products will be removed.	Requirement 1 Legal Requirment Requirement			
1.5	To Control Output	This will control the output of electricity and heat so that it will be accessed without the significant fluctuation.	Requirement 8 Performance Requirement			
1.5.1	To Control Electricity Output	The electricity will be outputted to the transmission line.	Requirement 8 Performance Requirement			
1.5.2	To Control Heat Output	The Output control will access according to the demand.	Requirement 8 Performance Requirement			
1.6	To Access The Demand	This will access the demand form the client.	Requirement 8.4 Operation Instruction Requirement			
1.6.1	To Access Electricity Demand	This will access the electricity demand from the client.	Requirement 8 Performance Requirement			
1.6.1.1	To Distribute Electricity	This Function will distribute electricity.	Requirement 1 Legal Requirment			
1.6.2	To Feedback to Generation	This wills send a signal to the generator to control electricity production.	Requirement 4.1 Electricity Demand			Item Electricity Demand Feedback

1.6.3	To Access Heat Demand	This will gather the demand request and access the controller of the output to output the heat as needed.	Requirement 3.1 Heat Storage			
1.6.3.1	To Out Put Heat	The system generate electricity using power plant	Requirement 3 Heat Requirement			
1.6.3.2	To Store Excess Heat	The controller will adjust the heat and will feed it to the heat storage system.	Requirement 3.1 Heat Storage			
1.7	To Transmit Energy	This will transmit the final energy.	Requirement 11.1 Construction Cost			
1.8	To Maintain The System	This function will maintain the system 24/7 and continue the process described above.	Requirement 7.1 Maintenance Frequency Requirement 8.6 Verification			

FUNCTIONAL ANALYSIS SUMMARY

The functional analysis in this report is included to discretize large chunk of works into multiple small work orders. Each function is related with the appropriate requirements and will be modified accordingly as the requirements change. One example is the function of controlling heat out is related the performance requirement 8 which mentions to store the excess heat. When the heat out is designed, it is critical to design it according to the requirement. If the heat output is designed without considering the requirement the clients' customers will experience shortage of heat energy.

WORK BREAKDOWN

WORK BREAKDOWN STRUCTURE

- 1.Power Plant
- 1.1 Analysis Study
  - 1.1.1 System Requirement

- 1.1.1.1 Identify Process
- 1.1.1.2 Prepare Design and Prototype
  - 1.1.1.2.1 Power Plant Design
    - 1.1.1.2.1.1 Feasibility
    - 1.1.1.2.1.2 Functional analysis
    - 1.1.1.2.1.3 Requirements allocation
    - 1.1.1.2.1.4 Timeline analysis
    - 1.1.1.2.1.5 System analysis, synthesis and system integration
      - 1.1.1.2.1.5.1 System trade-off studies
      - 1.1.1.2.1.5.2 Life-cycle cost analysis
      - 1.1.1.2.1.5.3 System Synthesis
      - 1.1.1.2.1.5.4 System Integration
    - 1.1.1.2.1.6 Reliability Engineering
      - 1.1.1.2.1.6.1 Program Planning
      - 1.1.1.2.1.6.2 Analyses and Predictions
      - 1.1.1.2.1.6.3 Test and Evaluation

- 1.1.1.2.1.7 Maintainability Engineering
- 1.1.1.2.1.7.1 Program Planning
- 1.1.1.2.1.7.2 Analyses and Predictions
- 1.1.1.2.1.7.3 Test and Evaluation
- 1.1.1.2.1.8 Human Factors Engineering
- 1.1.1.2.1.8.1 Program Planning
- 1.1.1.2.1.8.2 System functional task analysis
- 1.1.1.2.1.8.3 Training Requirements
- 1.1.1.3 Detail Technical Requirement/Detailed Engineering
- 1.1.1.3.1 Project Engineering
- 1.1.1.3.2 Mechanical Engineering
- 1.1.1.3.3 Process Engineering
- 1.1.1.3.4 Pipe Engineering
- 1.1.1.3.5 Civil/Structure Engineering
- 1.1.1.3.6 Electrical/Instrumentation Engineering
- 1.1.1.4 Review hardware and Software

- 1.2 Development
  - 1.2.1 Data Migration
    - 1.2.1.1 Identify Data Requirements
    - 1.2.1.2 Collect Planning and Procurement Data
    - 1.2.1.3 Collect Production Resources Data
    - 1.2.1.4 Input and Upload Data
    - 1.2.1.5 Verify and Correct Migrated Data
- 1.3 Testing and Training
  - 1.3.1 Mock Testing
    - 1.3.1.1 Verify Planning, Result and Schedule
    - 1.3.1.2 Verify Procurement Module ,Cost and End Result
    - 1.3.1.3 Perform Unit Test
    - 1.3.1.4 Perform Integration Test
    - 1.3.1.5 Monitor and Control Scope Quality, time and cost
    - 1.3.1.6 Resolve Problem
  - 1.3.2 End User Testing

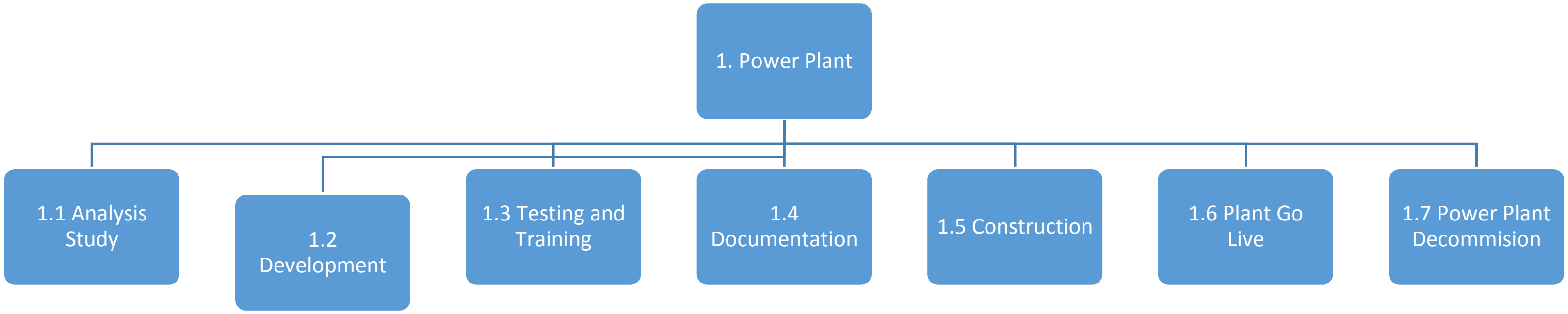
- 1.3.2.1 Conduct in House Training
- 1.4 Documentation
- 1.4.1 Finalize Review and Acceptance
- 1.4.1.1 Final System Design Review
- 1.4.1.1.1 Process Licensing and Permits
- 1.4.1.1.2 Report Environmental Impacts
- 1.4.1.1.2.1 Prepare Toxic Report of The Selected Fuel
- 1.4.1.1.2.2 Prepare Visual Environmental Impacts
- 1.4.1.1.2.3 Prepared Noise Environmental Impacts.
- 1.4.1.1.3 Preliminary Project Schedule
- 1.4.1.1.4 Final Design/Drawings
- 1.4.1.1.5 Specifications
- 1.4.1.1.6 Final Cost Estimates
- 1.4.1.1.7 Procurement
- 1.4.2 End user Training Documentation
- 1.4.3 Record in change in control and system modification

- 1.5 Construction
    - 1.5.1 Site Selection
    - 1.5.2 Site Preparation
    - 1.5.3 Foundations
    - 1.5.4 Structure Erection
    - 1.5.5 Building Service
    - 1.5.6 Commissioning
- 1.6 Plant Go live
    - 1.6.1 Post Go live
        - 1.6.1.1 Data Integrity Check
        - 1.6.1.2 System Performance Monitoring
- 1.7 Power Plant Decommissioning
    - 1.7.1 Assessment/Design
        - 1.7.1.1 Environmental/Hazardous Materials Assessments
        - 1.7.1.2 Abatement and Deconstruction
        - 1.7.1.3 Cost Estimates

- 1.7.1.4 Milestone Schedule
- 1.7.2 Hazardous Materials Removal
- 1.7.2.1 Oil Filled Electrical Equipment
- 1.7.2.2 Tanks and Pipelines
- 1.7.2.3 Asbestos Containing Materials
- 1.7.2.4 Lead-Based Paint
- 1.7.3 Building Demolition
- 1.7.3.2 Equipment Salvage
- 1.7.3.2Materials Segregation/Recycling
- 1.7.3 Closure Documentation
- 1.7.3.1Regulatory Submittals
- 1.7.3.2 Company Documentation

WORK BREAKDOWN DIAGRAM

Level 1



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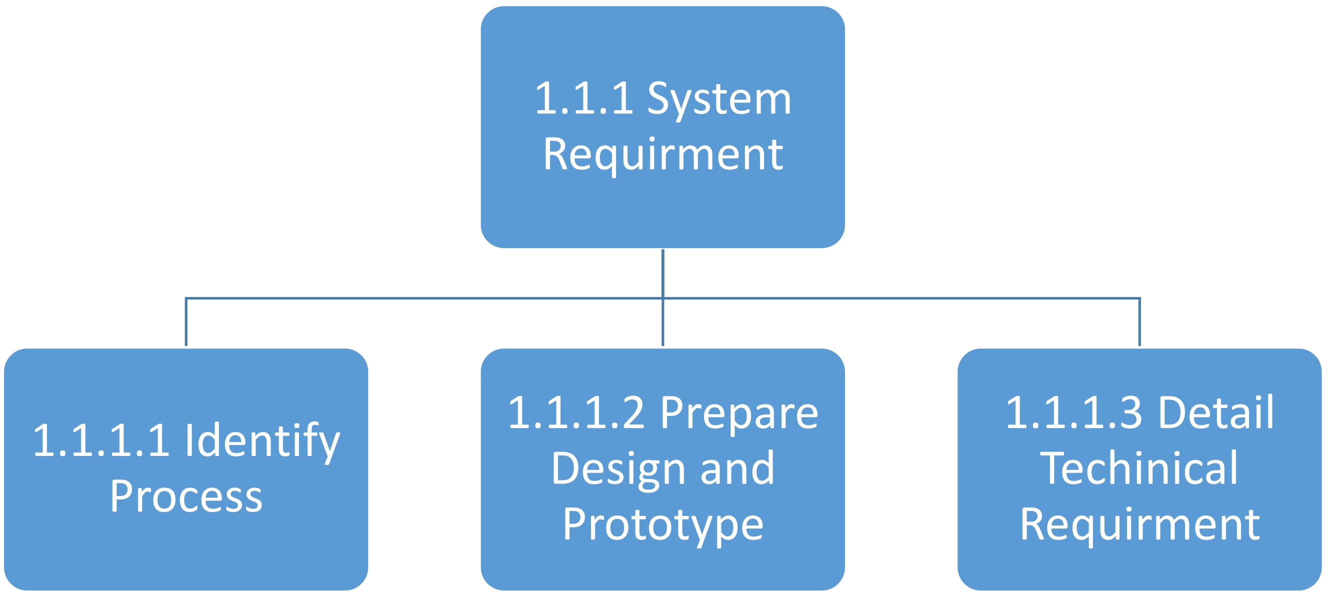
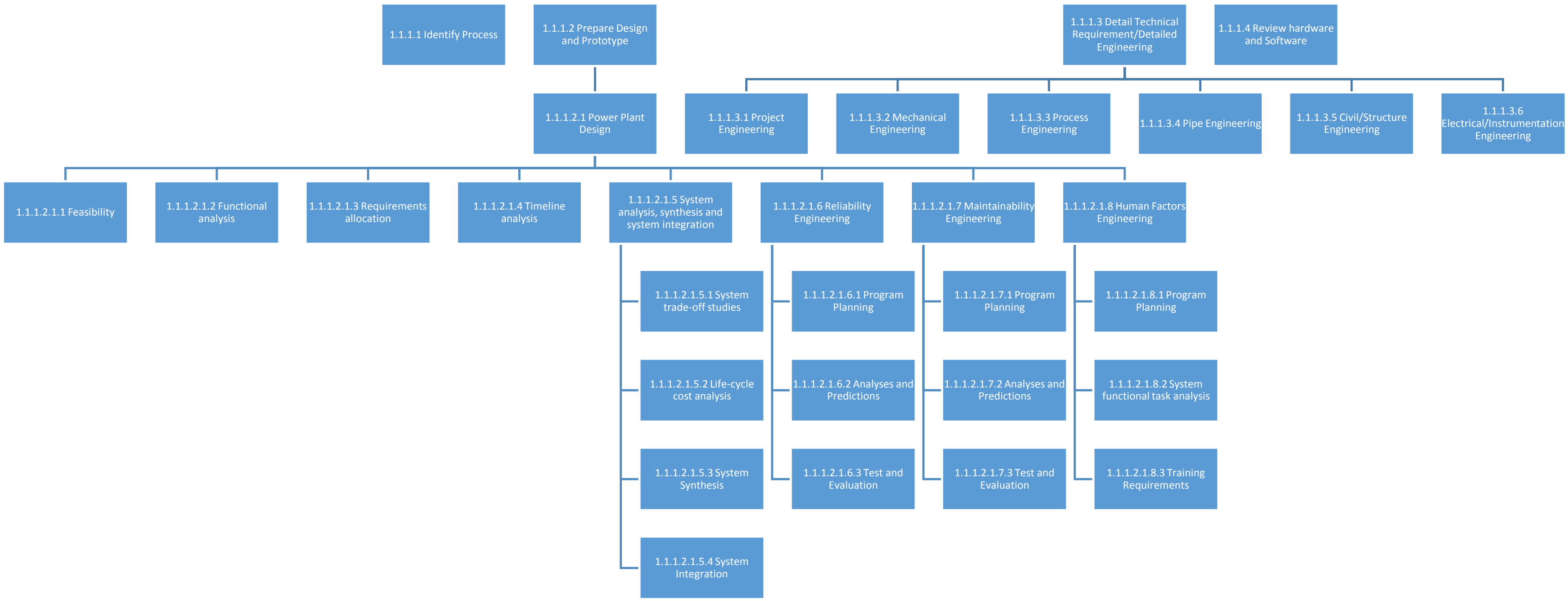


Level 2, 3, 4, 5 Starting 1.1



Level 2,3,4,5 Starting 1.3

- 1.3 Testing and Training
  - 1.3.1 Mock Testing
    - 1.3.1.1 Verify Planning, Result and Schedule
    - 1.3.1.2 Verify Procurement Module ,Cost and End Result
    - 1.3.1.3 Perform Unit Test
    - 1.3.1.4 Perform Integration Test
    - 1.3.1.5 Monitor and Control Scope Quality, time and cost
    - 1.3.1.6 Resolve Problem
  - 1.3.2 End User Testing
    - 1.3.2.1 Conduct in House Training
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  - 1.4.1 Finalize Review and Acceptance
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      - 1.4.1.1.1 Process Licensing and Permits
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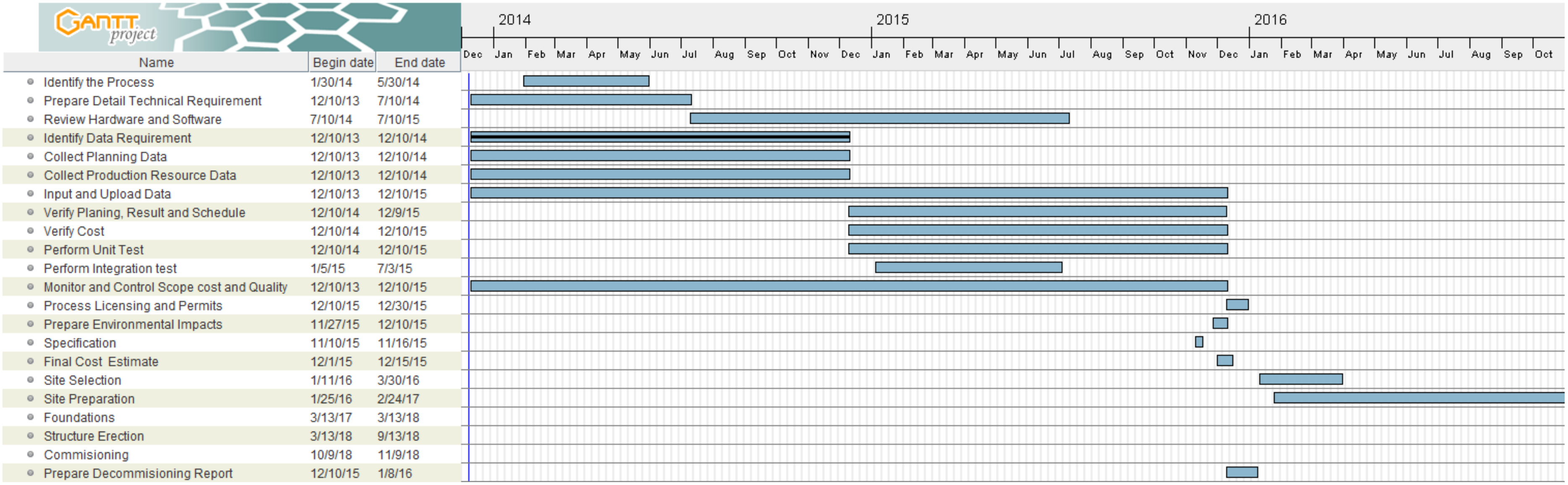
        - 1.4.1.1.2.1 Prepare Toxic Report of The Selected Fuel
        - 1.4.1.1.2.2 Prepare Visual Environmental Impacts
        - 1.4.1.1.2.3 Prepared Noise Environmental Impacts.
      - 1.4.1.1.3 Preliminary Project Schedule
      - 1.4.1.1.4 Final Design/Drawings
      - 1.4.1.1.5 Specifications
      - 1.4.1.1.6 Final Cost Estimates
      - 1.4.1.1.7 Procurement
  - 1.4.2 End user Training Documentation
  - 1.4.3 Record in change in control and system modification
- 1.5 Construction
  - 1.5.1 Site Selection
  - 1.5.2 Site Preparation
  - 1.5.3 Foundations
  - 1.5.4 Structure Erection
  - 1.5.5 Building Service
  - 1.5.6 Commissioning
- 1.6 Plant Go live
  - 1.6.1 Post Go live
    - 1.6.1.1 Data Integrity Check
    - 1.6.1.2 System Performance Monitoring
- 1.7 Power Plant Decommissioning
  - 1.7.1 Assessment/Design
    - 1.7.1.1 Environmental/Hazardous Materials Assessments
    - 1.7.1.2 Abatement and Deconstruction
    - 1.7.1.3 Cost Estimates
    - 1.7.1.4 Milestone Schedule
  - 1.7.2 Hazardous Materials Removal
    - 1.7.2.1 Oil Filled Electrical Equipment
    - 1.7.2.2 Tanks and Pipelines
    - 1.7.2.3 Asbestos Containing Materials
    - 1.7.2.4 Lead-Based Paint
  - 1.7.3 Building Demolition
    - 1.7.3.2 Equipment Salvage
    - 1.7.3.2Materials Segregation/Recycling
  - 1.7.3 Closure Documentation
    - 1.7.3.1Regulatory Submittals
    - 1.7.3.2 Company Documentation

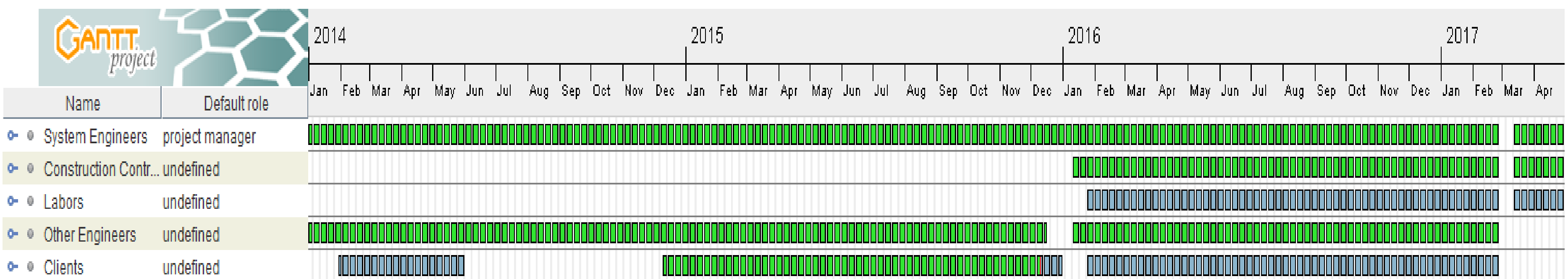
SCHEDULE

TASK SCHEDULE



Name	Begin date	End date
Identify the Process	1/30/14	5/30/14
Prepare Detail Technical Requirement	12/10/13	7/10/14
Review Hardware and Software	7/10/14	7/10/15
Identify Data Requirement	12/10/13	12/10/14
Collect Planning Data	12/10/13	12/10/14
Collect Production Resource Data	12/10/13	12/10/14
Input and Upload Data	12/10/13	12/10/15
Verify Planing, Result and Schedule	12/10/14	12/9/15
Verify Cost	12/10/14	12/10/15
Perform Unit Test	12/10/14	12/10/15
Perform Integration test	1/5/15	7/3/15
Monitor and Control Scope cost and Quality	12/10/13	12/10/15
Process Licensing and Permits	12/10/15	12/30/15
Prepare Environmental Impacts	11/27/15	12/10/15
Specification	11/10/15	11/16/15
Final Cost Estimate	12/1/15	12/15/15
Site Selection	1/11/16	3/30/16
Site Preparation	1/25/16	2/24/17
Foundations	3/13/17	3/13/18
Structure Erection	3/13/18	9/13/18
Commisioning	10/9/18	11/9/18
Prepare Decommisioning Report	12/10/15	1/8/16

HUMAN RESOURCE SCHEDULE



Name	Default role
System Engineers	project manager
Construction Contr...	undefined
Labors	undefined
Other Engineers	undefined
Clients	undefined

TEST AND EVALUATION MASTER PLAN

Test and Evaluation Master Plan (TEMP)								
Number	**Name**	**Test**	**Owner**	**Resources and Test Facilites**	**Support Equipment**	**Place of Test**	**Test Admistrtor**	**Special Expectation**
1	Legal Requirment	Inspection	Client		Legal Agreement Document	Indoor	Client	
1.1	Iowa Legal Code	Inspection	Client	Iowa Legal Code Document	Legal Agreement Document	Indoor	Client	
1.2	Federal Power Act	Inspection	Client	EPA Policy BooK	Legal Agreement Document	Indoor	Client	
1.3	Energy Policy Act	Inspection	Client	EPA Policy BooK	Legal Agreement Document	Indoor	Client	
2	Inputs Requirement							
2.1	Energy Source	Inspection	Client	EPA Policy BooK	Legal Agreement Document	Indoor	Client	
3	Heat Requirement		Client					
3.1	Heat Storage	Analaysis	Client	Collected Data and Plant Site	Design Used	Plant Site	System Engineer	
4	Electricity Requirement							
4.1	Electricity Demand	Instrumented	System Engineer	Collected Data	Real Time Data	Plant Site	System Engineer	
4.2	Power Output	Analysis	Client	Collected Data and Plant Site	Measurment Instrument	Plant Site	System Engineer	
4.3	Power Surge	Analysis	System Engineer	Collected Data and Plant Site	Measurment Instrument	Plant Site	System Engineer	
4.4	Steady State Frequency	Instrumented	System Engineer	Collected Data and Plant Site	Measurment Instrument	Plant Site	System Engineer	
4.5	Tie Breaker Design	Instrumented	System Engineer	Collected Data and Plant Site		Plant Site	System Engineer	This should be done in low demand time, to avoid potetional problem if failed.
4.6	Voltage Deviation	Instrumented	System Engineer	Collected Data and Plant Site	Measurment Instrument	Plant Site	System Engineer	
5	Construction Requirement		Client					
5.1	Construction Time	Analysis	Client	Analysis of Projection of Cost	Cost Estimation Softwares		Client	
6	Design Certification Requirement		Client					
6.1	Document Certification	Inspection	Client	Check Signed Documend	Legal Agreement Document	Indoor	Client	
6.2	Test Certification	Inspection	Client	Check Signed Documend	Legal Agreement Document	Indoor	Client	
7	Saftey Requirement							
7.1	Maintenance Frequency	Analysis	System Engineer	Check Reports	Reports	Indoor	System Engineer	
7.2	Work Place Inspections	Inspection	System Engineer	Check Reports	Legal Agreement Document	Indoor	Client	
8	Performance Requirement		Client					
8.1	Operating Capacity	Analysis	System Engineer	Recorded and Real Time data			System Engineer	
8.2	Operating Efficiency	Analysis	System Engineer	Recorded and Real Time data			System Engineer	
8.3	Operating Time	Demonstration	System Engineer	Recorded and Real Time data			System Engineer	
8.4	Operation Instruction	Inspection	System Engineer	Recorded and Real Time data	Legal Agreement Document	Indoor	Client	
8.5	Real Time Data	Demonstraion	System Engineer	Recorded and Real Time data			System Engineer	
8.6	Verification	Inspection	System Engineer	Recorded and Real Time data	Legal Agreement Document	Indoor	Client	
9	Recycling Requirement	Analysis	System Engineer	Check Design			System Engineer	
10	Schedual Requriement	Analysis	Client	Check Design			Client	
11	Cost Requirement		Client					
11.1	Construction Cost	Demonstration	Client	Cost Report			Client	
11.2	Design Cost	Demonstration	Client	Cost Report			Client	

CONFIGURATION MANAGEMENT PLAN

CM OBJECTIVES AND OVERVIEW

The purpose of the Configuration Management Plan is to document and inform project stakeholders related to modification in the system. This will make it possible to identify, organize and control modifications focuses on to the system by reducing error.

This document helps to identify and baseline configuration items, control modification of configuration items, report and record status of configuration items, ensure consistency of configuration items and control transportation of configuration items though out the system.

CM ORGANIZATION, CHARTER, MEMBERS AND DUTIES

- All stakeholder of the plant should consult recorded or expert advice before continuing with their process.
- Each group is responsible to communication any significant change that is made to the plant.
- All employee are expected to report any changes that is done by them which might affect the plant operating capacity before the scheduled life time.
- The plant will have a configuration control board which periodically check and update the configuration management plan. Each team will have at least one configuration control member which will notify the others and update as need if any change in her/his group occurred.
- Online, but will only be accessed through company server, library for any change will be introduced later as a maintenance producer.

BASELINE MANAGEMENT

Up to date version of hardware and software which were approved by the system engineer, the client and the stakeholders will be included in this report. Any revision should be included in the document with a detailed reasoning. Internal baseline report will also be included in this document.

All changes that will be occurred due to the introduction of the new version will also be included in this document.

ARCHIVAL

This document will include the length of archive for each type of data the will be collected from the power plant.

TRAINING

All the training that necessary to familiarize the employee and the stakeholders with the change in the system will be documented here.

REFERENCE USED

1. "Battery and Energy Technologies." *Energy Efficiency*. N.p., n.d. Web. 09 Dec. 2013.
2. Blanchard, Benjamin S., and W. J. Fabrycky. *Systems Engineering and Analysis*. Upper Saddle River, NJ: Pearson Prentice Hall, 2006. Print.
3. Buede, Dennis M. *The Engineering Design of Systems: Models and Methods*. New York: Wiley, 2000. Print.
4. "Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service." *Federal Power Act*. N.p., n.d. Web. 10 Dec. 2013.
5. "Menu." *Introduction to SYS 201*. N.p., n.d. Web. 10 Dec. 2013.

Appendix

1 Originating Requirements

1 Legal Requirement

Refined By Subordinate Requirements:
- 1.1 Iowa Legal Code
- 1.2 Federal Power Act
- 1.3 Energy Policy Act

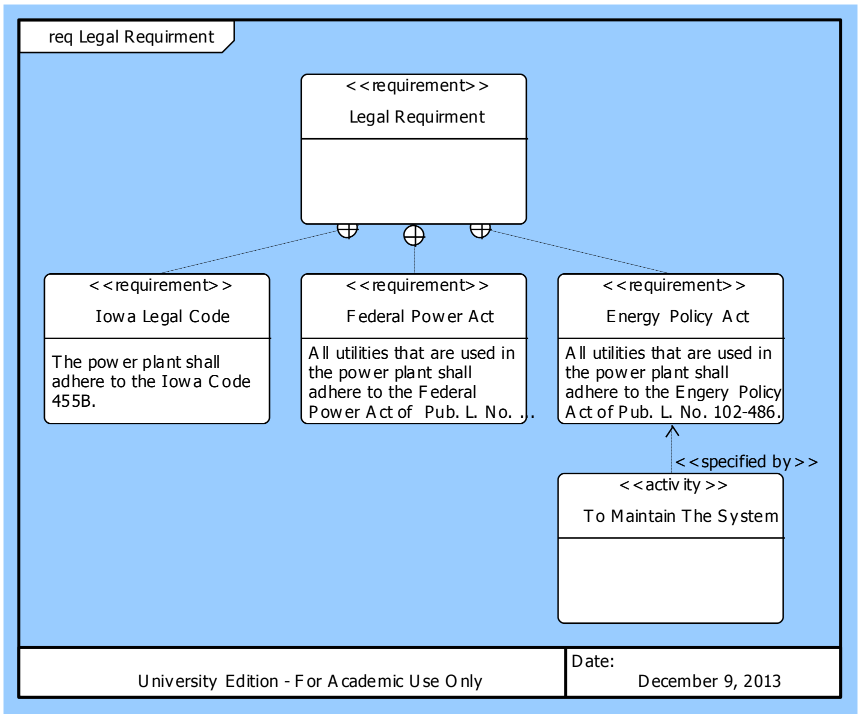


Figure 1 Legal Requirement Requirements Diagram

1.1 Iowa Legal Code

Requirement Statement:

The power plant shall adhere to the Iowa Code 455B.

Refines Higher-Level Requirement:

1 Legal Requirement

1.2 Federal Power Act

Requirement Statement:

All utilities that are used in the power plant shall adhere to the Federal Power Act of Pub. L. No. 95-617.

Refines

1 Originating Requirements

Higher-Level Requirement:
1 Legal Requirement

1.3 Energy Policy Act

Requirement Statement:
All utilities that are used in the power plant shall adhere to the Energy Policy Act of Pub. L. No. 102-486.

Refines Higher-Level Requirement:
1 Legal Requirement

Specifies:
Function: 1.8 To Maintain The System

2 Inputs Requirement

Refined By Subordinate Requirements:
2.1 Energy Source

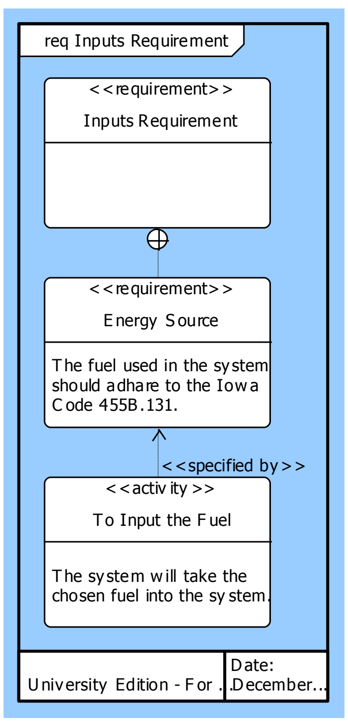


Figure 2 Inputs Requirement Requirements Diagram

2.1 Energy Source

Requirement Statement:
The fuel used in the system should adhare to the Iowa Code 455B.131.

1 Originating Requirements

Refines Higher-Level Requirement:
2 Inputs Requirement

Specifies:
Function: 1.1 To Input the Fuel

3 Heat Requirement

Refined By Subordinate Requirements:
3.1 Heat Storage

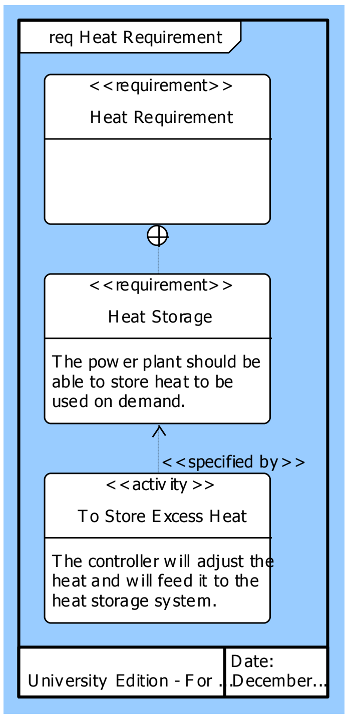


Figure 3 Heat Requirement Requirements Diagram

3.1 Heat Storage

Requirement Statement:
The power plant should be able to store heat to be used on demand.

Refines Higher-Level Requirement:
3 Heat Requirement

Specifies:
Function: 1.6.3.2 To Store Excess Heat

4 Electricity Requirement

Refined By Subordinate Requirements:

1 Originating Requirements

4.1 Electricity Demand
4.2 Power Output
4.3 Power Surge
4.4 Steady State Frequency
4.5 Tie Breaker Design
4.6 Voltage Deviation

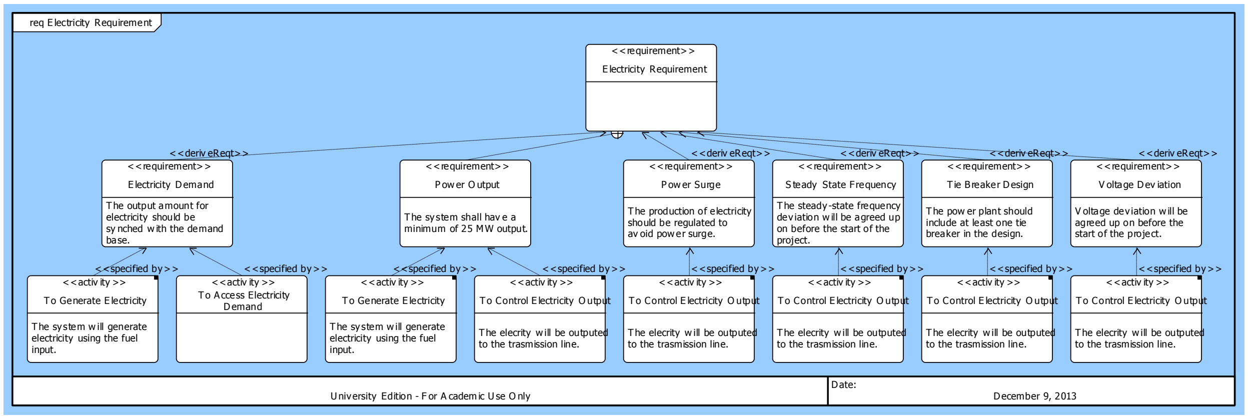


Figure 4 Electricity Requirement Requirements Diagram

4.2 Power Output

Requirement Statement:

The system shall have a minimum of 25 MW output.

Refines Higher-Level Requirement:

4 Electricity Requirement

Specifies:

Function: 1.3.1 To Generate Electricity
Function: 1.5.1 To Control Electricity Output

5 Construction Requirement

Refined By Subordinate Requirements:

5.1 Construction Time

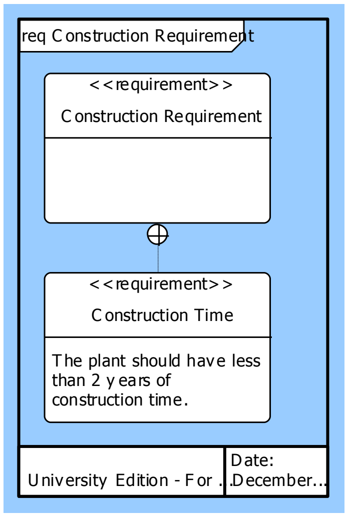


Figure 5 Construction Requirement Requirements Diagram

5.1 Construction Time

Requirement Statement:

The plant should have less than 2 years of construction time.

Refines Higher-Level Requirement:

5 Construction Requirement

6 Design Certification Requirement

Refined By Subordinate Requirements:

6.1 Document Certification

6.2 Test Certification

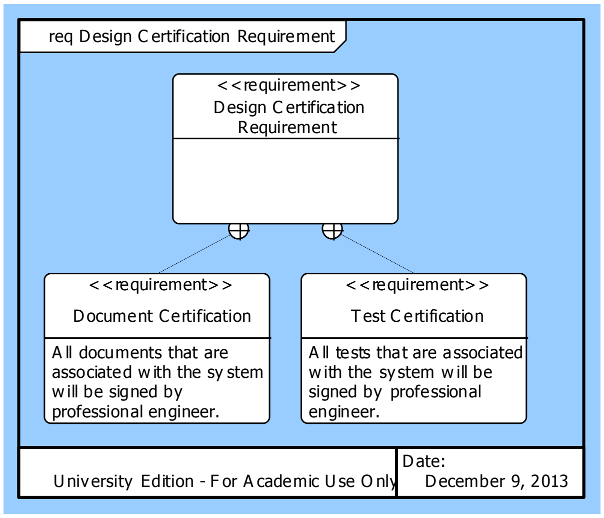


Figure 6 Design Certification Requirement Requirements Diagram

1 Originating Requirements

6.1 Document Certification

Requirement Statement:

All documents that are associated with the system will be signed by professional engineer.

Refines Higher-Level Requirement:

6 Design Certification Requirement

6.2 Test Certification

Requirement Statement:

All tests that are associated with the system will be signed by professional engineer.

Refines Higher-Level Requirement:

6 Design Certification Requirement

8 Performance Requirement

Refined By Subordinate Requirements:

8.1 Operating Capacity
8.2 Operating Efficiency
8.3 Operating Time
8.4 Operation Instruction
8.5 Real Time Data
8.6 Verification

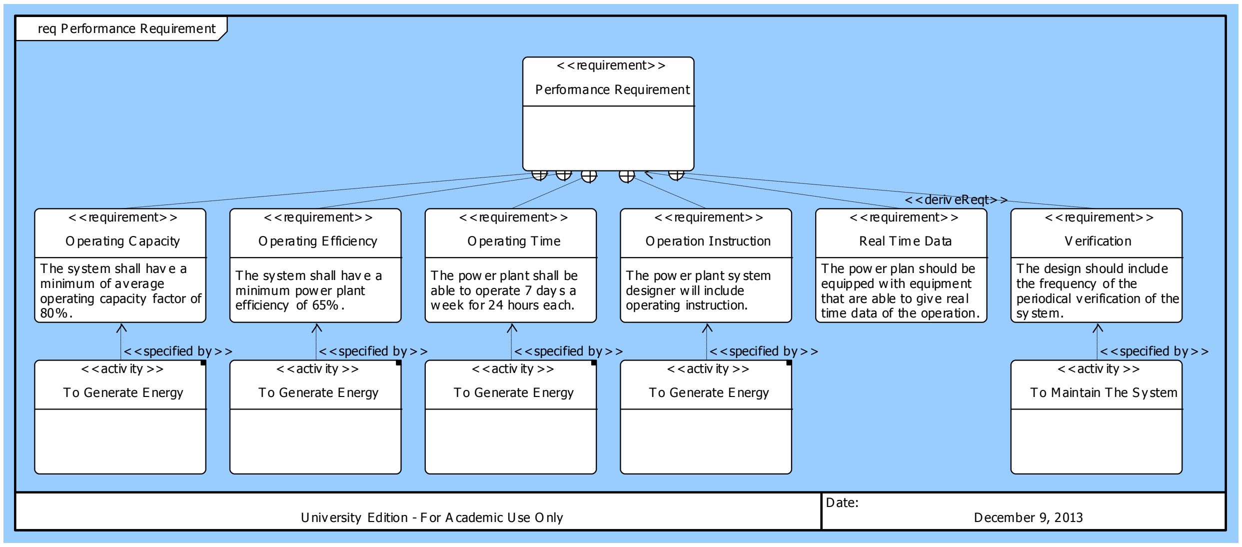


Figure 7 Performance Requirement Requirements Diagram

1 Originating Requirements

8.1 Operating Capacity

Requirement Statement:

The system shall have a minimum of average operating capacity factor of 80%.

Refines Higher-Level Requirement:

8 Performance Requirement

Specifies:

Function: 1.3 To Generate Energy

8.2 Operating Efficiency

Requirement Statement:

The system shall have a minimum power plant efficiency of 65%.

Refines Higher-Level Requirement:

8 Performance Requirement

Specifies:

Function: 1.3 To Generate Energy

8.3 Operating Time

Requirement Statement:

The power plant shall be able to operate 7 days a week for 24 hours each.

Refines Higher-Level Requirement:

8 Performance Requirement

Specifies:

Function: 1.3 To Generate Energy

8.4 Operation Instruction

Requirement Statement:

The power plant system designer will include operating instruction.

Refines Higher-Level Requirement:

8 Performance Requirement

Specifies:

Function: 1.3 To Generate Energy

8.6 Verification

Requirement Statement:

The design should include the frequency of the periodical verification of the system.

Refines Higher-Level Requirement:

8 Performance Requirement

Specifies:
Function: 1.8 To Maintain The System

10 Schedule Requirement

Requirement Statement:
The plant should have a minimum of 30 years plant life.

11 Cost Requirement

Refined By Subordinate Requirements:
11.1 Construction Cost
11.2 Design Cost

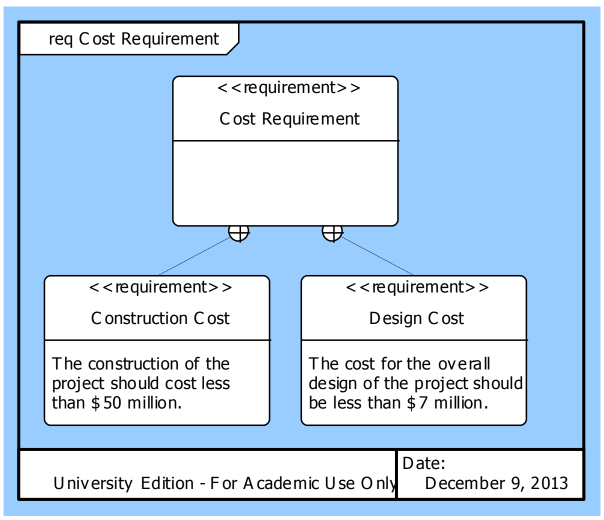


Figure 8 Cost Requirement Requirements Diagram

11.1 Construction Cost

Requirement Statement:
The construction of the project should cost less than $50 million.

Refines Higher-Level Requirement:
11 Cost Requirement

11.2 Design Cost

Requirement Statement:
The cost for the overall design of the project should be less than $7 million.

Refines Higher-Level Requirement:
11 Cost Requirement

5 Construction Requirement

Refined By Lower-Level Requirements:

5.1 Construction Time

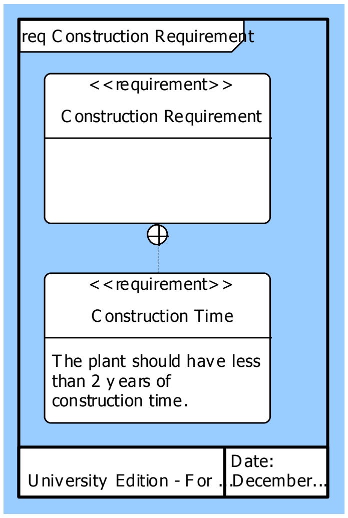


Figure 9 Construction Requirement Requirements Diagram

5.1 Construction Time

Design Constraint Statement:

The plant should have less than 2 years of construction time.

Refines Higher-Level Requirement:

5 Construction Requirement

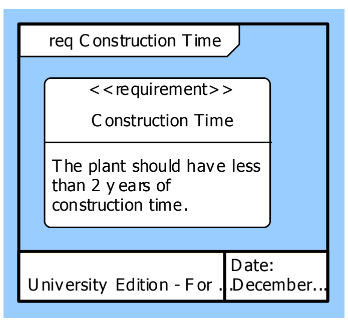


Figure 10 Construction Time Requirements Diagram

11 Cost Requirement

Refined By Lower-Level Requirements:

11.1 Construction Cost

11.2 Design Cost

2 Design Constraints

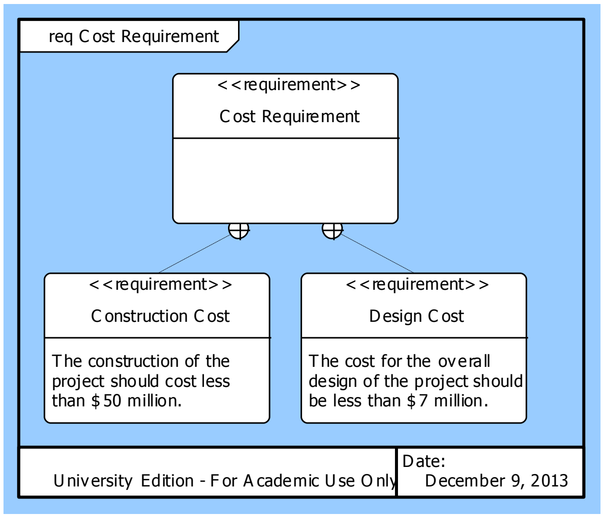


Figure 11 Cost Requirement Requirements Diagram

11.1 Construction Cost

Design Constraint Statement:

The construction of the project should cost less than $50 million.

Refines Higher-Level Requirement:

11 Cost Requirement

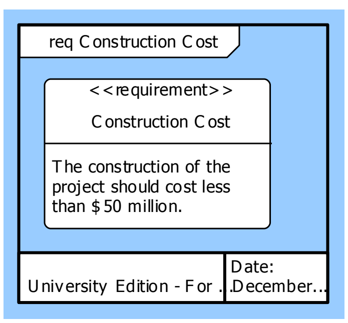


Figure 12 Construction Cost Requirements Diagram

11.2 Design Cost

Design Constraint Statement:

The cost for the overall design of the project should be less than $7 million.

Refines Higher-Level Requirement:

11 Cost Requirement

2 Design Constraints

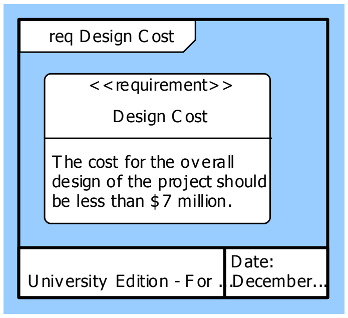


Figure 13 Design Cost Requirements Diagram

3 Performance Requirements

3 Heat Requirement

Refined By Lower-Level Requirements:

3.1 Heat Storage

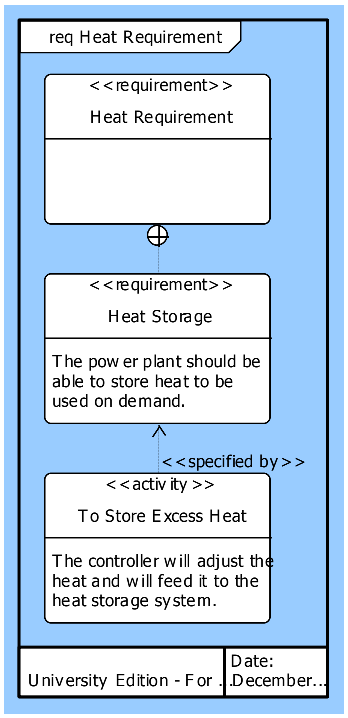


Figure 14 Heat Requirement Requirements Diagram

3.1 Heat Storage

Performance Requirement Statement:

The power plant should be able to store heat to be used on demand.

Refines Higher-Level Requirement:

3 Heat Requirement

Specifies:

Function: 1.6.3.2 To Store Excess Heat

3 Performance Requirements

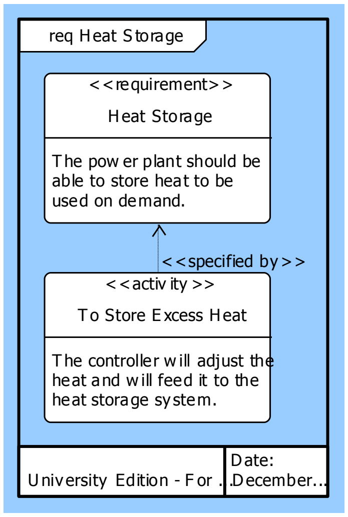


Figure 15 Heat Storage Requirements Diagram

4 Electricity Requirement

Refined By Lower-Level Requirements:

4.1 Electricity Demand
4.2 Power Output
4.3 Power Surge
4.4 Steady State Frequency
4.5 Tie Breaker Design
4.6 Voltage Deviation

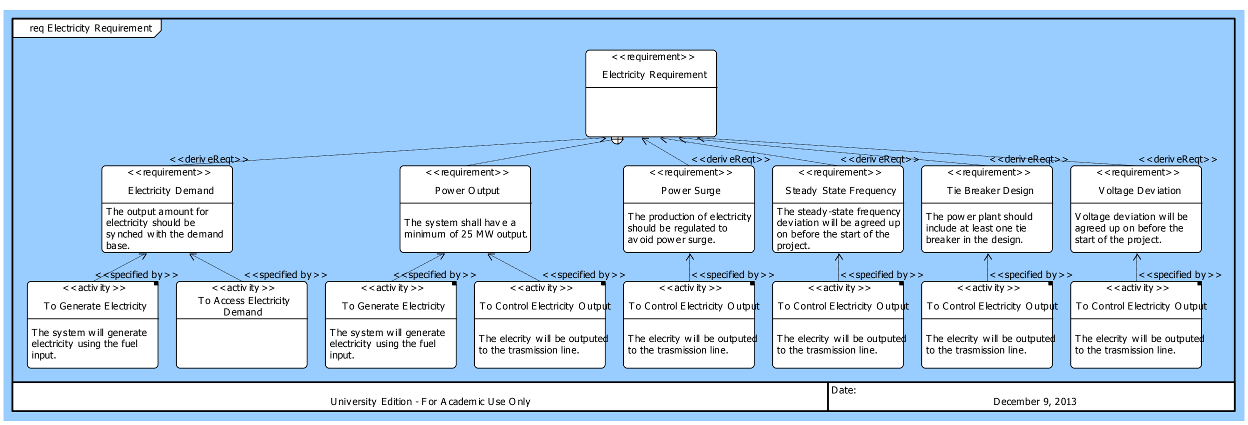


Figure 16 Electricity Requirement Requirements Diagram

4.1 Electricity Demand

Performance Requirement Statement:

The output amount for electricity should be synched with the demand base.

Refines Higher-Level Requirement:

4 Electricity Requirement

Specifies:

Function: 1.3.1 To Generate Electricity

Function: 1.6.1 To Access Electricity Demand

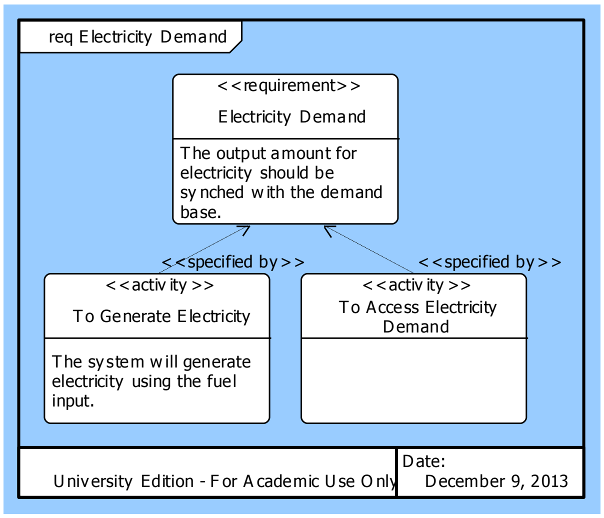


Figure 17 Electricity Demand Requirements Diagram

4.2 Power Output

Performance Requirement Statement:

The system shall have a minimum of 25 MW output.

Refines Higher-Level Requirement:

4 Electricity Requirement

Specifies:

Function: 1.3.1 To Generate Electricity

Function: 1.5.1 To Control Electricity Output

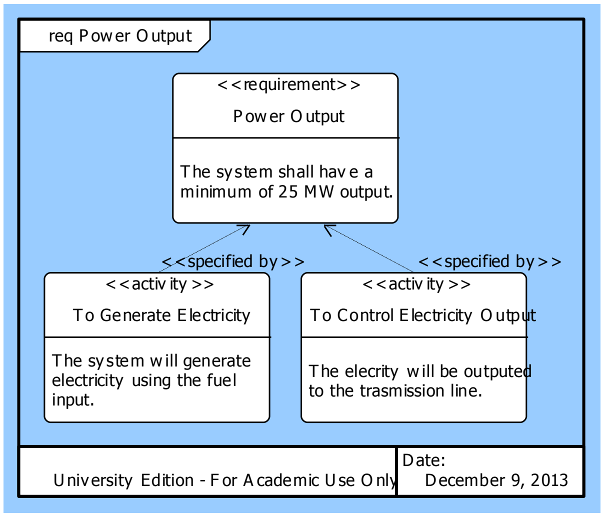


Figure 18 Power Output Requirements Diagram

4.3 Power Surge

Performance Requirement Statement:

The production of electricity should be regulated to avoid power surge.

Refines Higher-Level Requirement:

4 Electricity Requirement

Specifies:

Function: 1.5.1 To Control Electricity Output

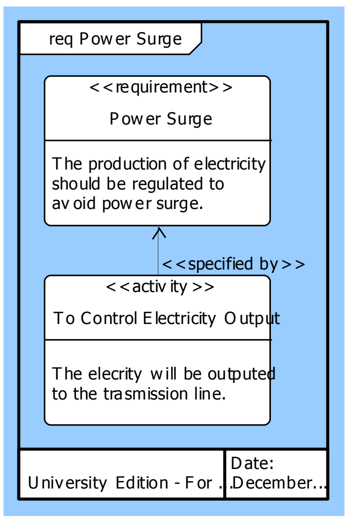


Figure 19 Power Surge Requirements Diagram

4.4 Steady State Frequency

Performance Requirement Statement:

The steady-state frequency deviation will be agreed up on before the start of the project.

Refines Higher-Level Requirement:

4 Electricity Requirement

Specifies:

Function: 1.5.1 To Control Electricity Output

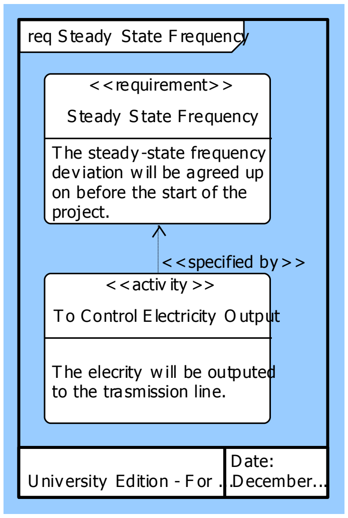


Figure 20 Steady State Frequency Requirements Diagram

4.5 Tie Breaker Design

Performance Requirement Statement:

The power plant should include at least one tie breaker in the design.

Refines Higher-Level Requirement:

4 Electricity Requirement

Specifies:

Function: 1.5.1 To Control Electricity Output

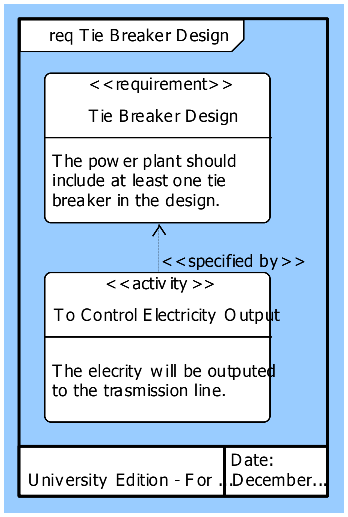


Figure 21 Tie Breaker Design Requirements Diagram

4.6 Voltage Deviation

Performance Requirement Statement:

Voltage deviation will be agreed up on before the start of the project.

Refines Higher-Level Requirement:

4 Electricity Requirement

Specifies:

Function: 1.5.1 To Control Electricity Output

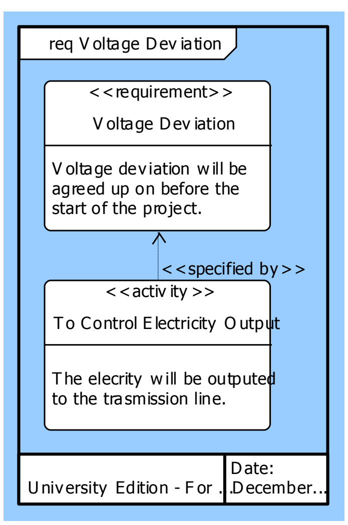


Figure 22 Voltage Deviation Requirements Diagram

7 Saftey Requirement

Refined By Lower-Level Requirements:

3 Performance Requirements

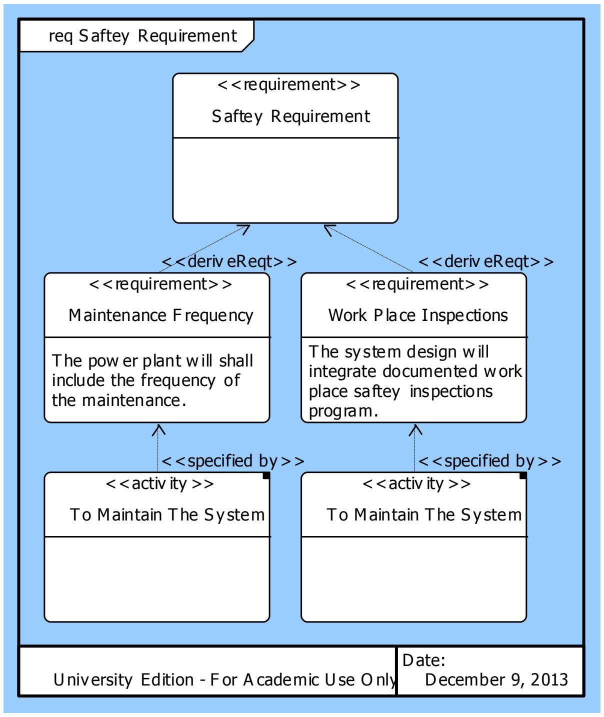


Figure 23 Saftey Requirement Requirements Diagram

7.1 Maintenance Frequency

Performance Requirement Statement:

The power plant will shall include the frequency of the maintenance.

Refines Higher-Level Requirement:

7 Saftey Requirement

Specifies:

Function: 1.8 To Maintain The System

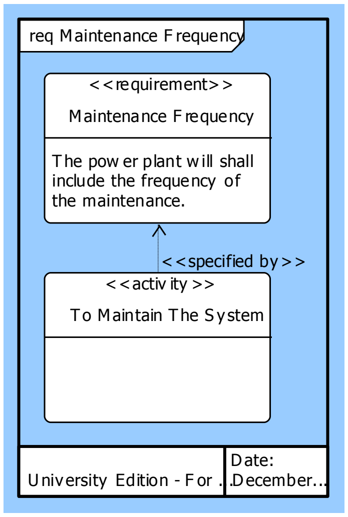


Figure 24 Maintenance Frequency Requirements Diagram

7.2 Work Place Inspections

Performance Requirement Statement:

The system design will integrate documented work place safety inspections program.

Refines Higher-Level Requirement:

7 Safety Requirement

Specifies:

Function: 1.8 To Maintain The System

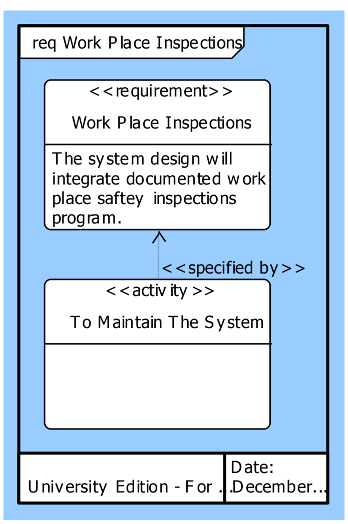


Figure 25 Work Place Inspections Requirements Diagram

8 Performance Requirement

Refined By Lower-Level Requirements:

3 Performance Requirements

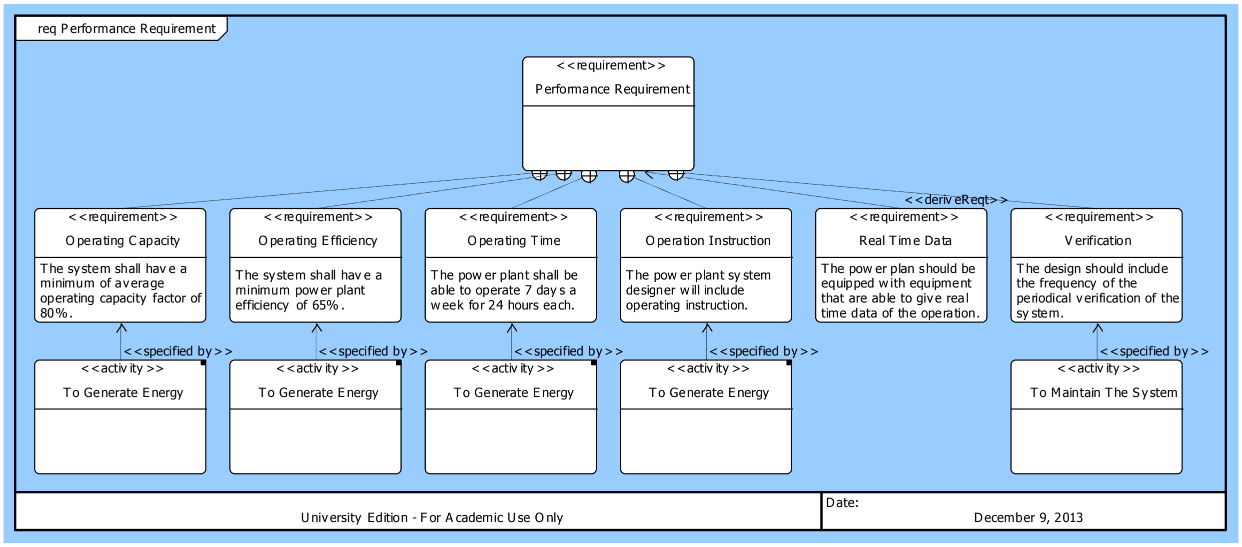


Figure 26 Performance Requirement Requirements Diagram

8.1 Operating Capacity

Performance Requirement Statement:

The system shall have a minimum of average operating capacity factor of 80%.

Refines Higher-Level Requirement:

8 Performance Requirement

Specifies:

Function: 1.3 To Generate Energy

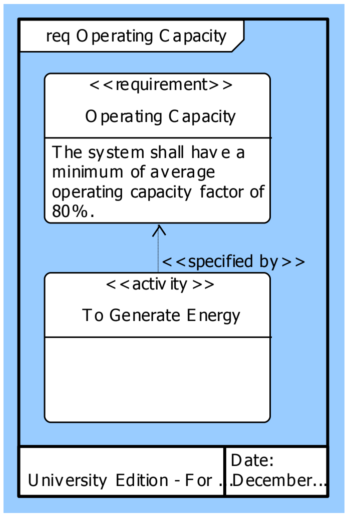


Figure 27 Operating Capacity Requirements Diagram

8.2 Operating Efficiency

Performance Requirement Statement:

The system shall have a minimum power plant efficiency of 65%.

Refines Higher-Level Requirement:

8 Performance Requirement

Specifies:

Function: 1.3 To Generate Energy

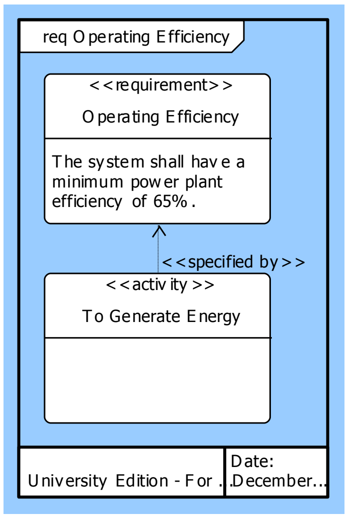


Figure 28 Operating Efficiency Requirements Diagram

8.3 Operating Time

Performance Requirement Statement:

3 Performance Requirements

The power plant shall be able to operate 7 days a week for 24 hours each.

Refines Higher-Level Requirement:
8 Performance Requirement

Specifies:
Function: 1.3 To Generate Energy

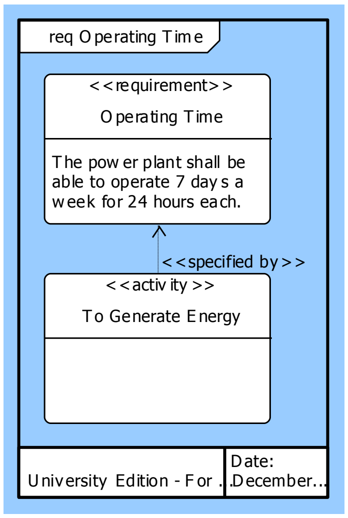


Figure 29 Operating Time Requirements Diagram

8.5 Real Time Data

Performance Requirement Statement:
The power plan should be equipped with equipment that are able to give real time data of the operation.

Refines Higher-Level Requirement:
8 Performance Requirement

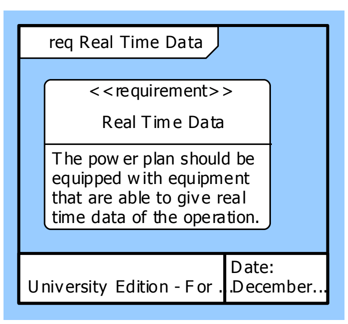


Figure 30 Real Time Data Requirements Diagram

9 Recycling Requirement

Performance Requirement Statement:

3 Performance Requirements

The system design should incorporate recycling system for the output.

Specifies:

Function: 1.4 To Recycle The Waste

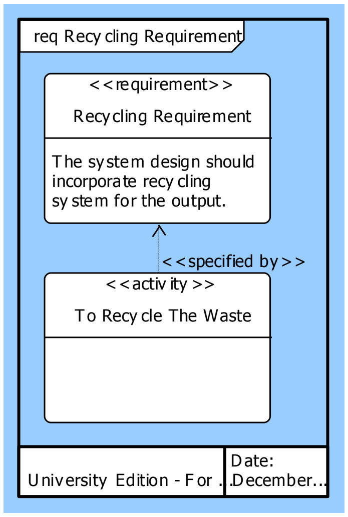


Figure 31 Recycling Requirement Requirements Diagram

10 Schedual Requriement

Performance Requirement Statement:

The plant should have a minimum of 30 years plant life.

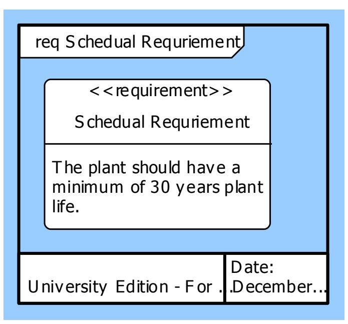


Figure 32 Schedule Requirement Requirements Diagram

4 Functional Behavior Model

Part I - Function List

1 Mission Functions
1.1 To Input the Fuel
1.2 To Control the Input
1.2.1 To Control Quality of Input
1.2.1.1 To Feed High Quality
1.2.1.2 To Remove Low Quality Input
1.2.2 To Control Rate of Input
1.3 To Generate Energy
1.3.1 To Generate Electricity
1.3.2 To Collect Heat
1.4 To Recycle The Waste
1.4.1 To Separate Waste
1.4.1.1 To Feed Recycled Input
1.4.1.2 To Remove Unrecyclable
1.5 To Control Output
1.5.1 To Control Electricity Output
1.5.2 To Control Heat Output
1.6 To Access The Demand
1.6.1 To Access Electricity Demand
1.6.1.1 To Distribute Electricity
1.6.2 To Feedback to Generation
1.6.3 To Access Heat Demand
1.6.3.1 To Out Put Heat
1.6.3.2 To Store Excess Heat
1.7 To Transmit Energy
1.8 To Maintain The System

Part II - Behavior Model

1 Mission Functions

4 Functional Behavior Model

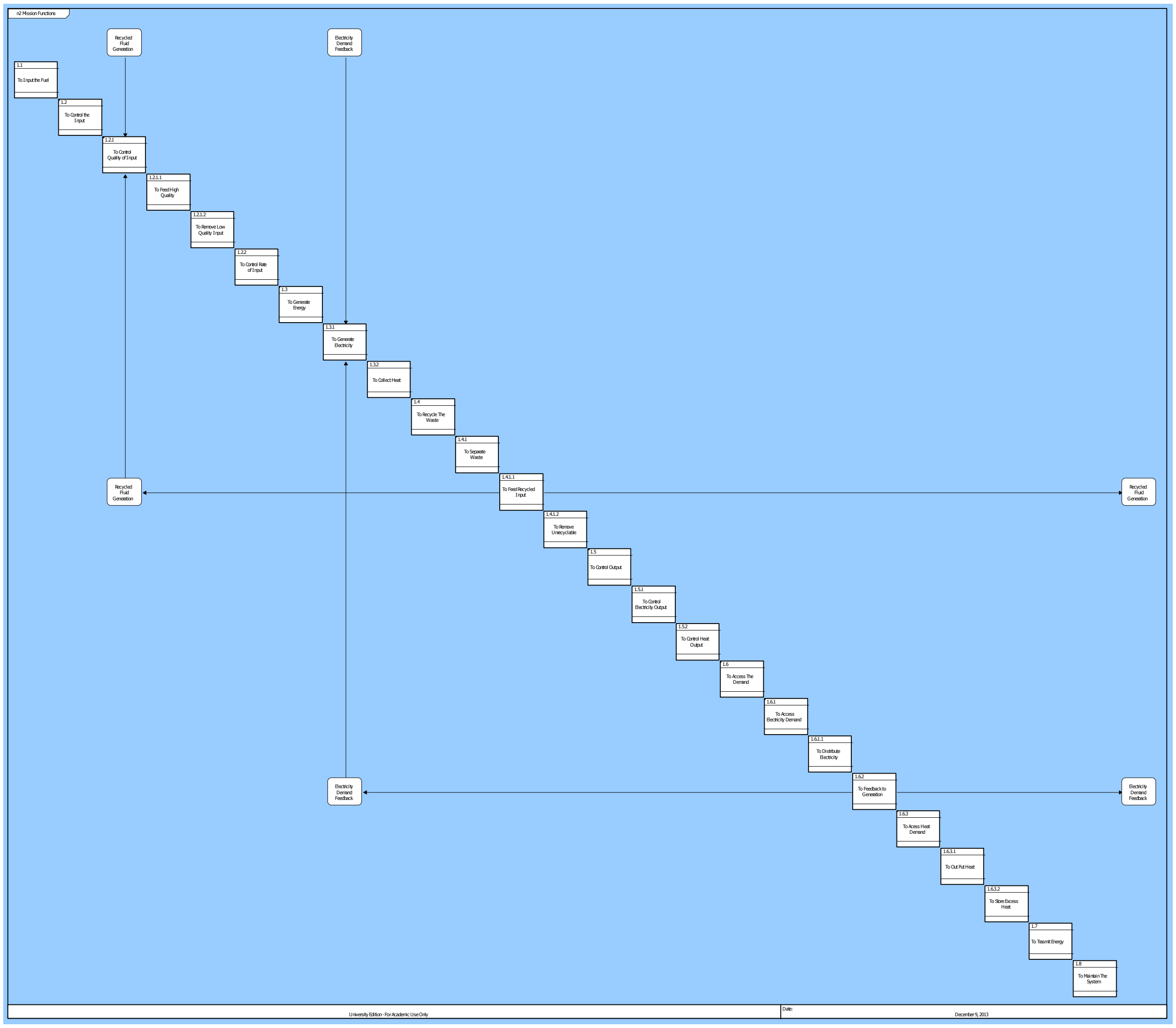


Figure 33 Mission Functions (N2 Diagram)

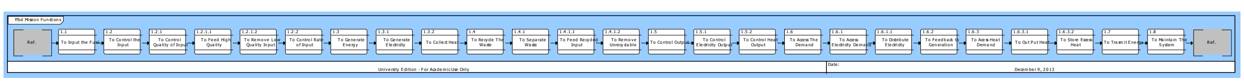


Figure 34 Mission Functions (FFBD)

1.1 To Input the Fuel

Description:

The system will take the chosen fuel into the system.

Specified By Requirements:

2.1 Energy Source

1.2 To Control the Input

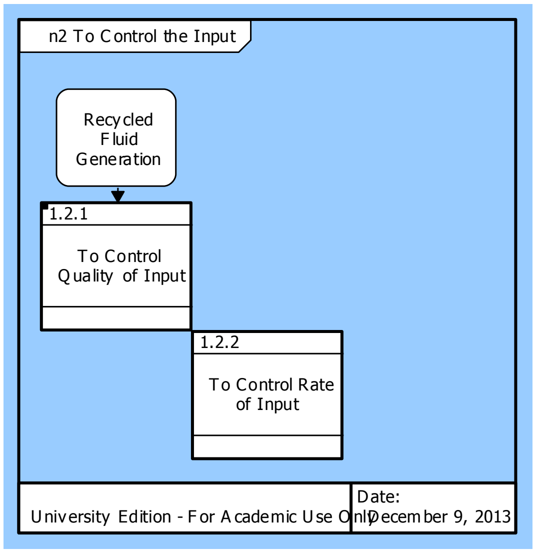


Figure 35 To Control the Input (N2 Diagram)

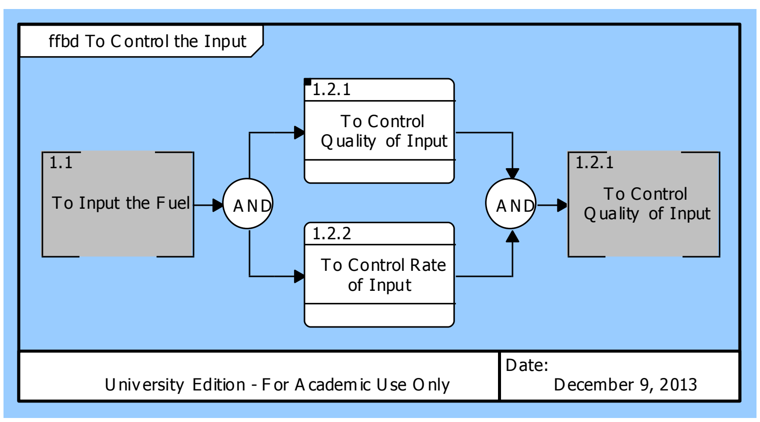


Figure 36 To Control the Input (FFBD)

1.2.1 To Control Quality of Input

Table 1 1.2.1 To Control Quality of Input Interfacing Items

Interfacing Items	Source / Destination
Recycled Fluid Generation	Input To: 1.2.1 To Control Quality of Input Output From: 1.4.1.1 To Feed Recycled Input

4 Functional Behavior Model

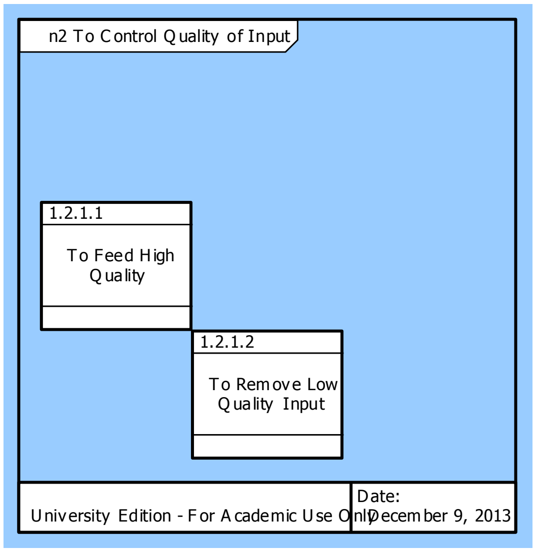


Figure 37 To Control Quality of Input (N2 Diagram)

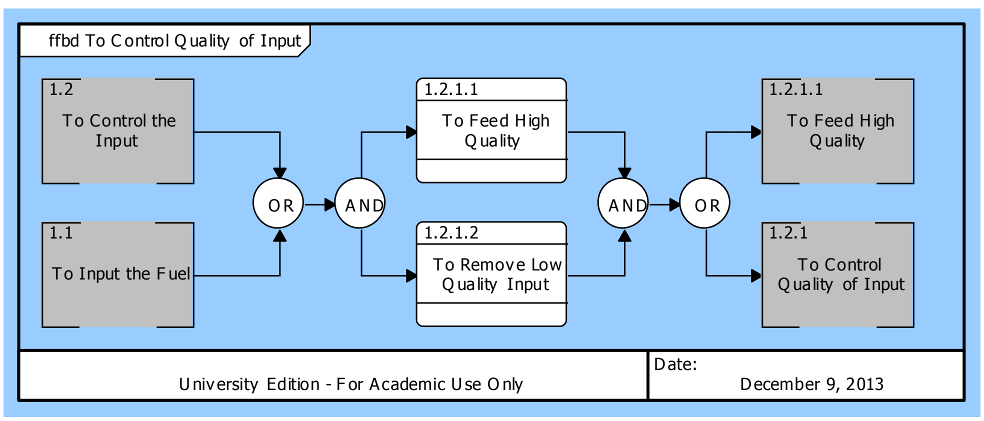


Figure 38 To Control Quality of Input (FFBD)

1.2.1.1 To Feed High Quality

1.2.1.2 To Remove Low Quality Input

Description:

Unrecyclable waste is extracted as final waste product out of the system.

1.2.2 To Control Rate of Input

1.3 To Generate Energy

Specified By Requirements:

8.1 Operating Capacity

4 Functional Behavior Model

8.2 Operating Efficiency
8.3 Operating Time
8.4 Operation Instruction

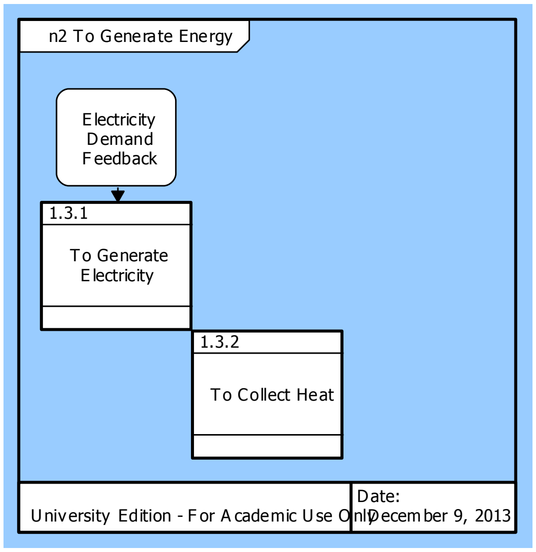


Figure 39 To Generate Energy (N2 Diagram)

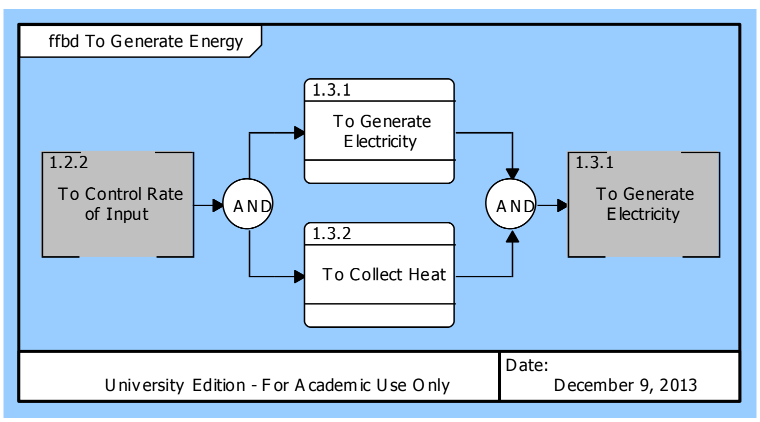


Figure 40 To Generate Energy (FFBD)

1.3.1 To Generate Electricity

Description:

The system will generate electricity using the fuel input.

Specified By Requirements:

4.1 Electricity Demand
4.2 Power Output

4 Functional Behavior Model

Table 2 1.3.1 To Generate Electricity Interfacing Items

Interfacing Items	Source / Destination
Electricity Demand Feedback	Input To: 1.3.1 To Generate Electricity Output From: 1.6.2 To Feedback to Generation

1.3.2 To Collect Heat

Description:
The system generate heat using the power plant.

1.4 To Recycle The Waste

Specified By Requirements:
9 Recycling Requirement

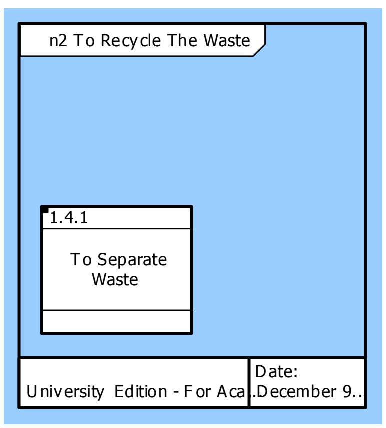


Figure 41 To Recycle The Waste (N2 Diagram)

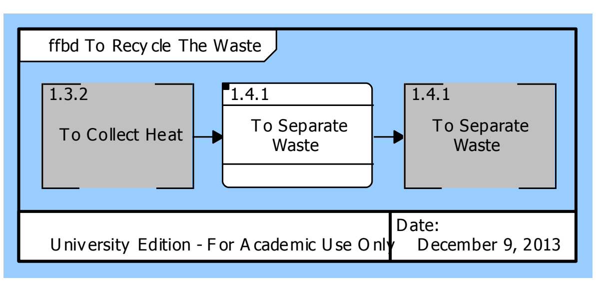


Figure 42 To Recycle The Waste (FFBD)

1.4.1 To Separate Waste

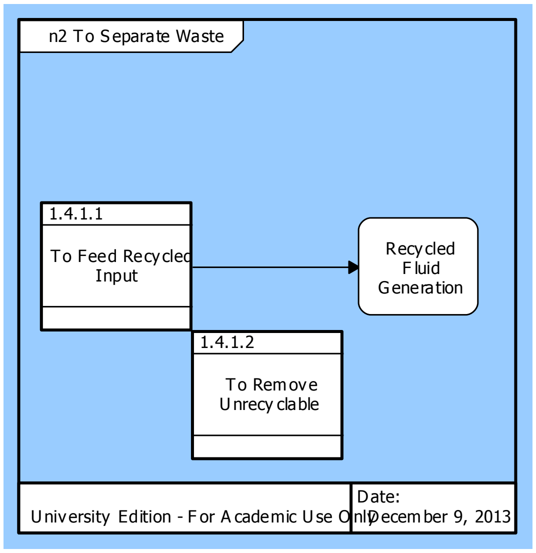


Figure 43 To Separate Waste (N2 Diagram)

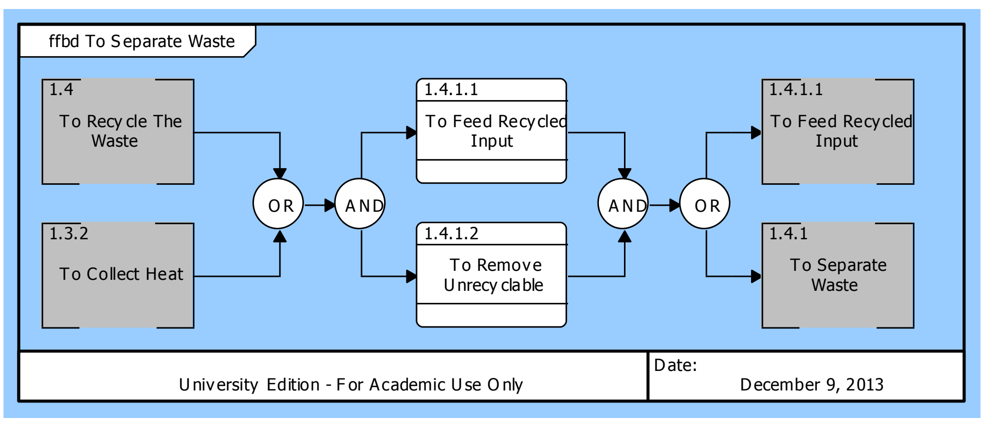


Figure 44 To Separate Waste (FFBD)

1.4.1.1 To Feed Recycled Input

Table 3 1.4.1.1 To Feed Recycled Input Interfacing Items

Interfacing Items	Source / Destination
Recycled Fluid Generation	Input To: 1.2.1 To Control Quality of Input Output From: 1.4.1.1 To Feed Recycled Input

1.4.1.2 To Remove Unrecyclable

1.5 To Control Output

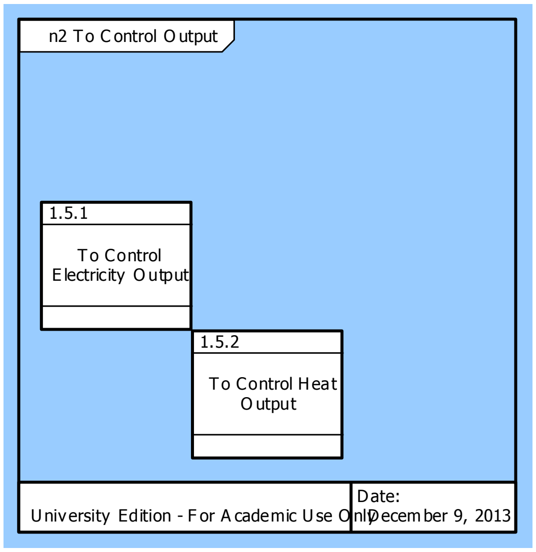


Figure 45 To Control Output (N2 Diagram)

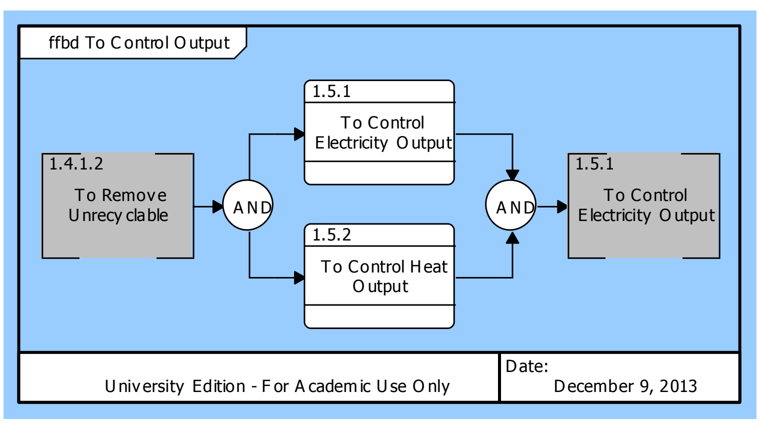


Figure 46 To Control Output (FFBD)

1.5.1 To Control Electricity Output

Description:

The elecrity will be outputed to the trasmission line.

Specified By Requirements:

4.2 Power Output

4.3 Power Surge

4.4 Steady State Frequency

4.5 Tie Breaker Design
4.6 Voltage Deviation

1.5.2 To Control Heat Output

Description:
The Output control will access according to the demand.

1.6 To Access The Demand

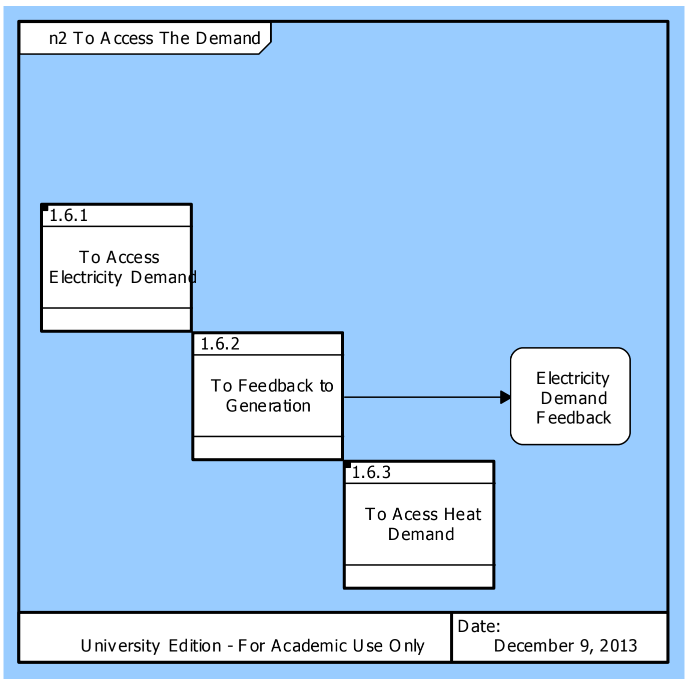


Figure 47 To Access The Demand (N2 Diagram)

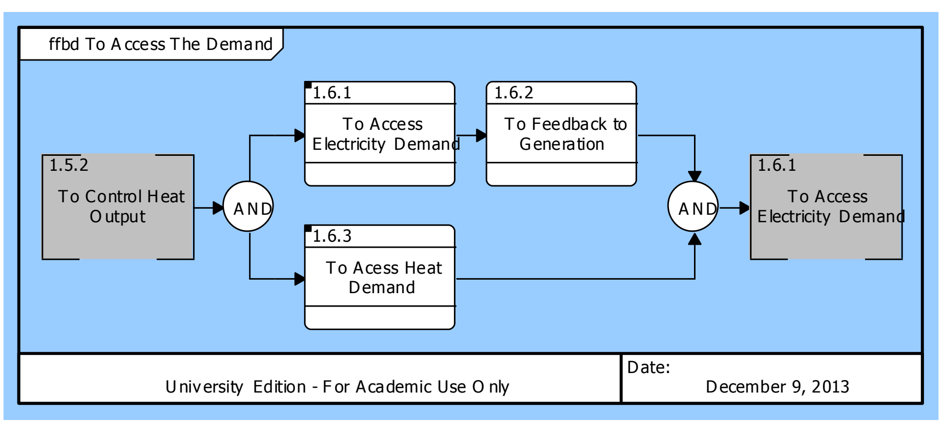


Figure 48 To Access The Demand (FFBD)

4 Functional Behavior Model

1.6.1 To Access Electricity Demand

Specified By Requirements:

4.1 Electricity Demand

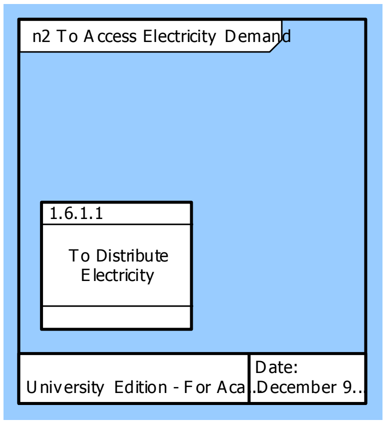


Figure 49 To Access Electricity Demand (N2 Diagram)

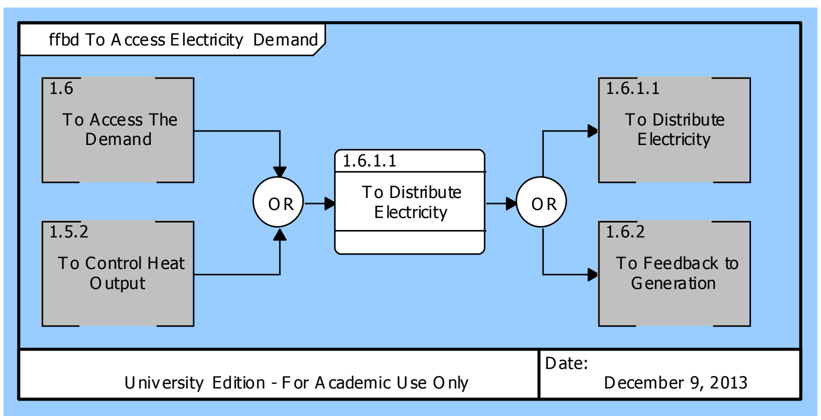


Figure 50 To Access Electricity Demand (FFBD)

1.6.1.1 To Distribute Electricity

1.6.2 To Feedback to Generation

Table 4 1.6.2 To Feedback to Generation Interfacing Items

Interfacing Items	Source / Destination
Electricity Demand Feedback	Input To: 1.3.1 To Generate Electricity Output From: 1.6.2 To Feedback to Generation

1.6.3 To Access Heat Demand

Description:

This will gather the demand request and access the controller of the output to output the heat as needed.

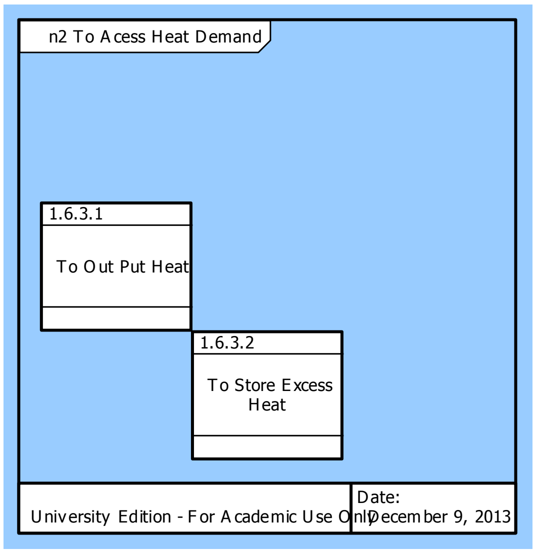


Figure 51 To Access Heat Demand (N2 Diagram)

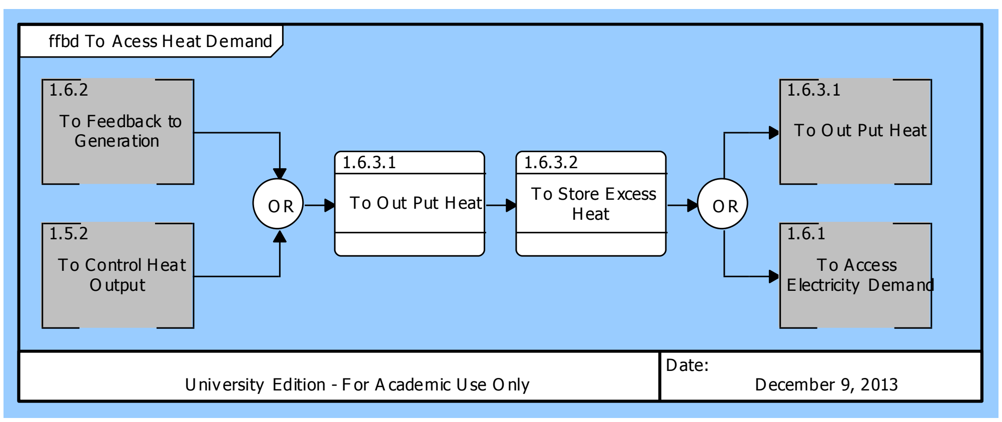


Figure 52 To Access Heat Demand (FFBD)

1.6.3.1 To Out Put Heat

Description:

The system generate electricity using power plant

4 Functional Behavior Model

1.6.3.2 To Store Excess Heat

Description:

The controller will adjust the heat and will feed it to the heat storage system.

Specified By Requirements:

3.1 Heat Storage

1.7 To Trasmit Energy

1.8 To Maintain The System

Specified By Requirements:

1.3 Energy Policy Act

7.1 Maintenance Frequency

7.2 Work Place Inspections

8.6 Verification