Table of Contents

Data Types

Attribute	Data Type	Allow Null?
Household		
Email	String	False
Square_Footage	Integer	False
HType	String	False
Utilities	List <String>	True
Regular_Thermostat_Setting	Integer	True
Has_heating	Boolean	False
Has_cooling	Boolean	False
Postal_Code		
PCode	String	False
City	String	False
State	String	False
Latitude	Float	False
Longitude	Float	False
Appliance		
BTU_Rating	Integer	False
Manufacturer	String	False
Model_name	String	True
Order_of_Entry	Integer	False
isDeleted	Boolean	false
Air_Handler		
Heating_Cooling_Method	List<String>	False
Air Conditioner		
Energy Efficiency Ratio	Float	False
Heater		
Source	String	False
Heat_Pump		
Seasonal_Energy_Efficiency_ Rating	Float	False
Heating_Seasonal Performance_Factor	Float	False

Water_Heater		
Capacity	Float	False
Current_Temperature_Setting	Integer	True
Energy Source	String	False
Battery Storage		
Capacity	Integer	False
Power_Generator		
Generation_Type	String	False
Avg_Monthly_kWh_Generated	Integer	False
Battery_Storage_Capacity	Integer	True
Order_of_Entry	Integer	False
isDeleted	Boolean	False
Manufacturer		
name	String	False

Business Logic Constraints

Application/Functionality:
- Any instance where a NULL value exists, NULL should be replaced with an empty string and not show "NULL".
- User should not be allowed to input postal code that does not match one listed in the database.
- The list of postal codes will not be changing.
- User should not be allowed to input an email address that already exists in the database.
- User can only leave thermostat setting for heating/cooling if they indicate there is No heat/No cooling.
- If an Appliance is deleted, the same Appliance number cannot be reused for another entry.
- Household power generation may be collected unless household is "off-the-grid".
- If a Power generator is deleted, the same generator number cannot be reused for another entry.
- Users are allowed to have multiple energy sources for the same type.

− Capturing appliance model name is optional.

Report Specific:
- − For missing or incorrect parameters, a report cannot be executed, an error message should be shown.
- − Tables, when displayed, must have an appropriate header row.
- − If a report does not return any results, an error message should be displayed instead of an empty table or blank page.
- − Ascending order for sort orders that are not specified.
- − Rounded numbers follow half rounds up if rounding not specified.
- − Household averages by radius report should include all postal codes whose distances are <= the distance input.

Task Decomposition and Abstract Code

Enter Household Information

Task Decomposition

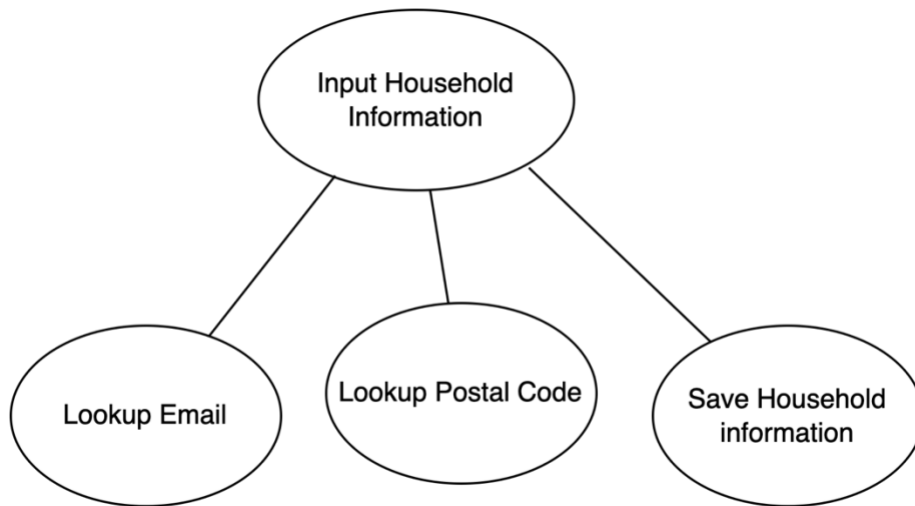**Lock Types: L**ookups of Email and Postal Code

Number of Locks: 2

Enabling Conditions: By User selecting "Enter my Household info" on Main Menu

Frequency: Around 100 times/day, Email and Postal Code have the same frequency

Consistency (ACID): Not critical, List of appliances for a particular household can be viewed even when an appliance or generator is being added to the household.

Subtasks: Mother task is required; lookup is done first to validate email and Postal code followed by Saving household

Abstract Code

Show Enter household info form

User enters *email address* (Input = String)

User enters five-digit *postal code* (Input = Integer)

User selects *Home type* from provided drop down menu

– Drop down menu contains following options: House, apartment, townhome, condominium, or mobile home

User enters *home Square footage* (Input = Integer)

Thermostat settings

User inputs *Thermostat setting for heating* and *Thermostat setting for cooling*

– If User choose *No heat* check box, *thermostat setting for heating* should be disabled.
– If User choose *No cooling* check box *thermostat setting for cooling* should be disabled.

User selects *Public utilities* from the provided list of checkboxes with the following options: Electric, Gas, Steam, Fuel Oil, multiple options are allowed.

Validate all household info form:

– *Email address* format
– If *email address* already exists in the database
– Length of *Postal Code*
– If *Postal Cod*e matches one that is listed in the database, run task **get postal code** from database, check if it exists in look database.

- If *Square footage* > 0
- *Thermostat setting for heating* is non null, if *No heat* is false
- *Thermostat setting for cooling* is non null, if *No cooling* is false

If any of these validations fail

- Show an Error message and display User prompt to provide valid response for the name of field
  - If email address exists, error prompt will display, "Email address already exists", if postal code is not in table, "No postal code exists in system", similarly for thermostat settings
- Show **Enter household info** form

User selects *Next* Button

Add Appliance
Task Decomposition

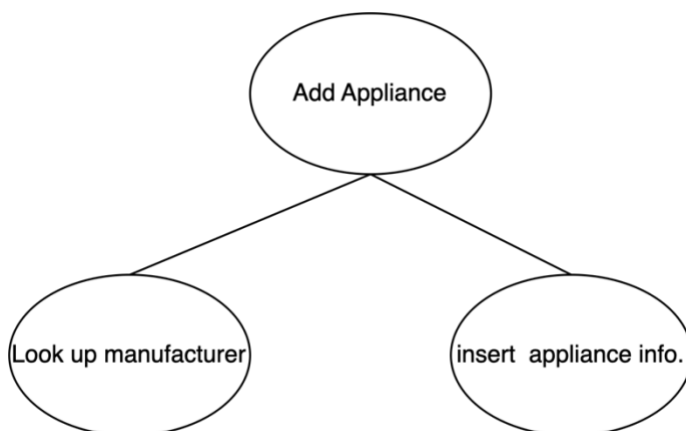**Lock Types:** Look up Manufacturer, Insert Appliance information

Number of Locks: 2

Enabling Conditions: By User successfully completing Household information Form

Frequency: Around 100 times/day

Consistency (ACID): Not critical, can be done in parallel while viewing an appliance

Subtasks: Look up Manufacturer, Insert Appliance Information

Abstract Code

Show **Add Appliance** form, User with no appliances added cannot skip add appliance form.

User selects *Appliance Type* from dropdown menu which shows two options: Air handler, Water heater

Look up Manufacturer and populate Manufacturer list

If User selects Air handler

– User shown information specific to Air handler
– User inputs *BTU rating* (Input = Float)
– User selects *Manufacturer* from drop down menu of options in database
– User can input *Model name* (Input = String)
– User selects *heating/cooling method*
    o If User selects Air Conditioner
– Show *Energy Efficiency Ratio* (EER)
– User inputs *EER* (Input = Float)
    o If User selects Heater
– Show *Energy source*
– User inputs *Energy Source* from drop down menu with options: Electric, Gas, Fuel Oil
    o If User selects Heat pump
– Show *Seasonal Energy Efficiency Rating* (SEER) and *Heating Seasonal Performance Facts* (HSPF) (Input = Float)
– User inputs *SEER* and *HSPF*

User clicks **Add** button

If User selects Water heater

– User shown information specific to Water heater
– User selects *Manufacturer* from drop down menu of options in database
– User can input *Model name* (Input = String)
– User selects *Energy Source* from drop down with options: Electric, gas, thermosolar, else heat pump
– User inputs *Capacity* (Input = Float)
– User inputs *BTU rating*
– User can input *Temperature* (Input = Integer)

User clicks **Add** button

Run the **Save appliance** task with appliance listing record for User with appliance number in the ascending order it exists in the system

Show next page **Appliance Listing** page

Get Appliance Listing
Task Decomposition

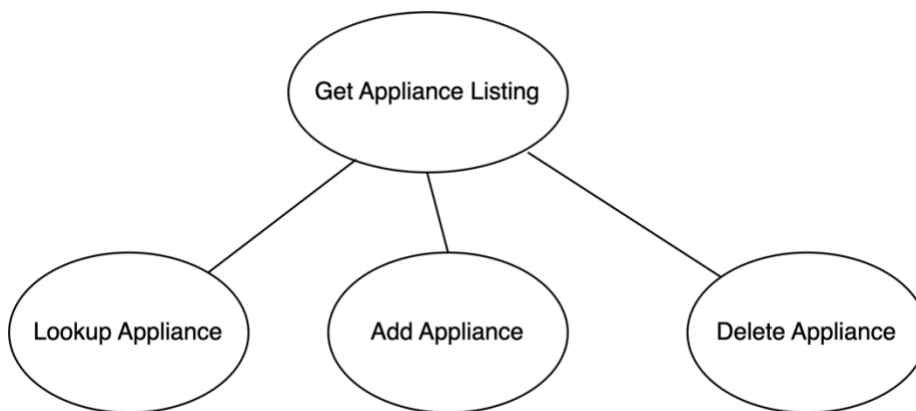**Lock Types:** Lookup Appliance Listing for each Household, Delete Appliance, Insert Appliance

Number of Locks: 3

Enabling Conditions: By completion of Add Appliance Form

Frequency: Around 100 times/day

Consistency (ACID): Not critical, all can be done in parallel

Subtasks: All tasks can be done but can be done in parallel, mother task is required to coordinate subtasks

Abstract Code

Show **<u>Appliance Listing</u>** Form

- Application Listing task
- Show appliance listing in order
- Appliance added first starts at 1.

If User clicks ***Add another appliance*** button

- Show User **<u>Add Appliance</u>** Form

If User clicks ***delete*** button

- Remove Appliance entry
- Validate that at least one appliance is added
- Update the deleted appliance with value is_deleted = True
- Validate if list appliance is zero, after deletion, show User **<u>Add Appliance</u>** Form, User is not allowed to go to next button with no appliance added in system.

If User clicks ***Next*** button

— Show next page, before next page run validation appliance count is more than 0, else show **Add appliance** page.

Add Power Generation

Task Decomposition

Lock Types: Lookup of Power Generation information, Lookup of Household Information, Insert Power generation information
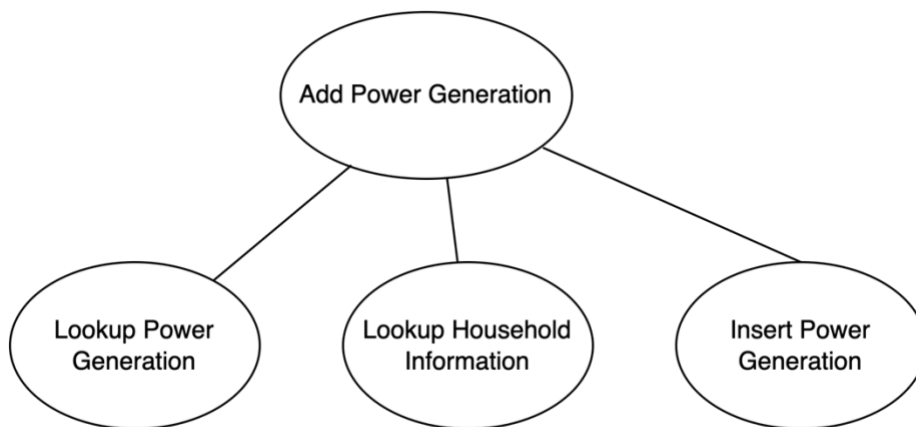
Number of Locks: 2

Enabling Conditions: By User successfully completing adding and editing Appliance information

Frequency: Around 100 visits/day

Consistency (ACID): Not critical

Subtasks: Lookup Power Generation, Lookup of Household Information, Insert Power Generation subtasks needed from mother task Add Power Generation

Abstract Code

Show **Add Power Generation** Form

Check Household information and derive if Household is off-the-grid or not

If Household is off-the-grid

- Does not have existing power generation
- *Skip* button should be disabled
- *Add* button should be enabled
- User inputs *Type* from dropdown menu which includes: Solar-electric or wind
- User inputs *Average Monthly kWh generate*d (Input = Integer)

- User can input *Storage* in kWh (Input = Integer)

User selects ***Add*** button which stores information into database

If Household is NOT off-the-grid

- ***Skip*** button should be enabled
    - o Allows User to skip adding power generation to finish submitting later
- ***Add*** button should be enabled

If User selects ***Skip***

- Show **Submission complete!** Form
    - o With option to ***Return to the main menu***

If User selects ***Add*** button

- User inputs *Type* from dropdown menu which includes: Solar-electric or wind
- User inputs *Average Monthly kWh generated* (Input = Integer)
- User can input *Storage* in kWh (Input = Integer)
- Call to validate data types
- If valid data types, true, call update method
    - o Update method: updates power generation record, calculates battery capacity based on kwh, if its null or empty there is no storage)

Power Generation Listing
Task Decomposition

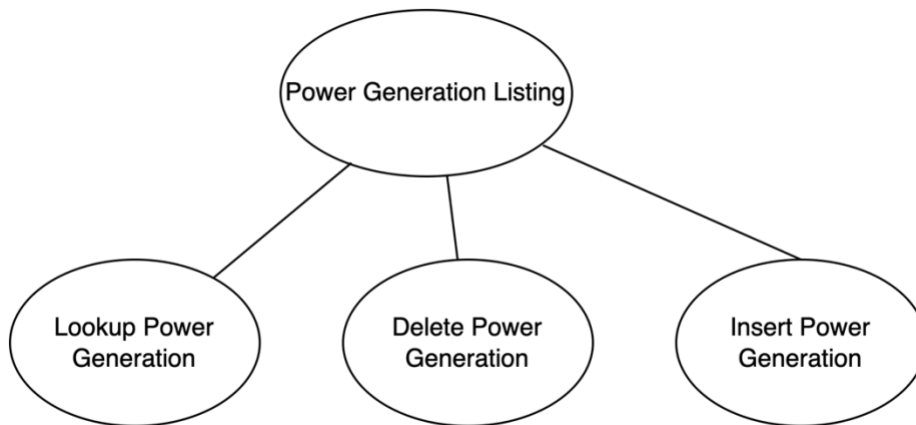**Lock Types:** Lookup Power Generation Listing for each Household, Delete Power Generation, Insert Power Generation

Number of Locks: 3

Enabling Conditions: By User successfully completing Add power generation Form

Frequency: Around 100 times/day

Consistency (ACID): Not critical, all can be done in parallel

Subtasks: All tasks can be done but can be done in parallel, mother task is required to coordinate subtasks

Abstract Code

Show **Power Generation Listing** Form

- − *Power Generation Listing* task
- − Show Power Generation listing in order of User input
- − Power Generation added first starts at 1.

If User clicks ***Add more power*** button

- − Show User **Add Power Generation** Form

If User clicks ***delete*** button

- − Remove Power Generation entry
- − Validate that at least one Power Generation is added
- − Update the deleted power generator with value is_deleted = True
- − Validate if list Power Generation is zero, after deletion show User **Add Power Generation** Form, User is not allowed to go to ***Finish*** button with no Power Generation added in system.

If count of listing is more than 0 and User is NOT off-the-grid enable ***Finish*** button

If User clicks ***Finish*** button

- − Show **Submission complete!** Form
  - o With option to ***Return to the main menu***

View Reports/Query Data

Task Decomposition

Lock Types: Lookup of Household Information

Number of Locks: Several different schemas are needed here

Enabling Conditions: By User accessing View reports/query data from Main Menu

Frequency: Around 100 times/day

Consistency (ACID): Critical

Subtasks: No task decomposition needed

Abstract Code

Show **View Reports** Page

Show links provided for following reports.

- o ***Top 25 popular manufacturers*** Report
- o ***Manufacturer/Model search*** Report
- o ***Heating cooling method details*** Report
- o ***Water heater statistics by state*** Report
- o ***Off-grid household*** Dashboard
- o ***Household average by radius*** Report

Detailed abstract code for each report.

Each report at the end has a ***Next*** and ***Previous*** button, to take back to the report dashboard where hyperlinks for all 6 reports are displayed.

View Reports Page has link to take to Main Menu where User can either ***Enter Household Information*** or ***View Reports/Query data***

Get Top 25 Popular Manufacturers

Task Decomposition

Lock Types: Lookup of Household Information

Number of Locks: 1

Enabling Conditions: By User selecting Top 25 Popular Manufacturers from View Reports page

Frequency: Around 100 times/day

Consistency (ACID): Not critical

Subtasks: No subtasks needed here

Abstract Code

Top 25 popular manufacturers Report is selected:

- No input needed, User can only view report
- Page will be displayed with top 25 manufacturers
- Page calls get the top 25 manufactures based on total appliances for the manufacturer
- When *drilldown report by manufacturer* is clicked
  - o   Show drilldown report by select manufacturer

Results are listed based on count descending of total appliances used.

Get Manufacturer/Model Search

Task Decomposition

Lock Types: Lookup Manufacturer Information, Lookup Appliance Information
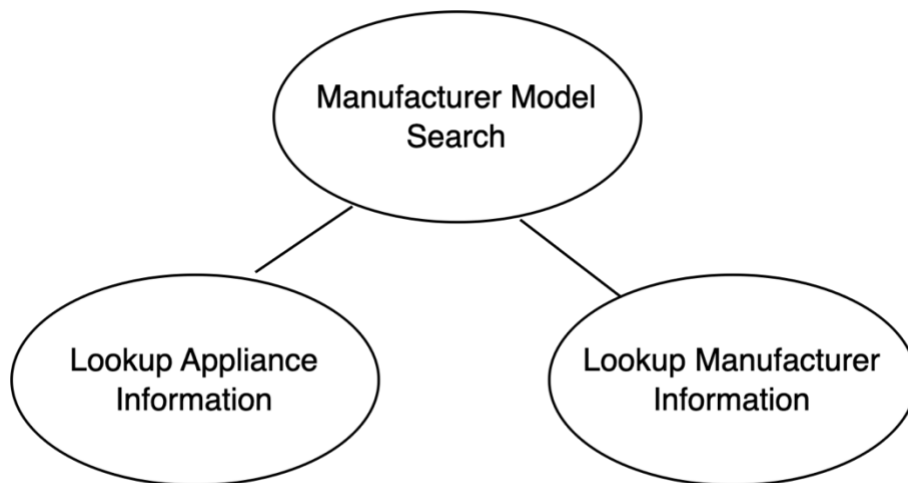
Number of Locks: 2

Enabling Conditions: By User selecting Manufacturer/Model Search from View Reports page

Frequency: Around 100 times/day

Consistency (ACID):

Subtasks: Lookup Manufacturer Information, Lookup Appliance Information

Abstract Code

Manufacturer/Model search Report is selected:

- Show search field for User to enter the query of string. (Form validation, no white space, or symbol)
- User enters search keywords, Hits **Search** button, input is validated for whitespaces and special characters
- Report shows ordered ascending for Manufacturer and Model name
- Results are pulled from the database to display the matching part for manufacturers and models. With matched string highlighted in green
- Since match is not string sensitive, hence User input is changed to lower case, back-end system in database stores in lower case string but description string which has proper camel casing. Search is performed against lowercased columns

Get Heating/Cooling Details

Task Decomposition

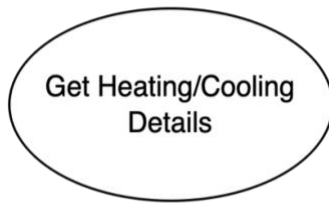**Lock Types:** Look up Appliance Information

Number of Locks: 1

Enabling Conditions: By User selecting Heating/Cooling Details Report from View Reports page

Frequency: Around 100 times/day

Consistency (ACID): Not Required

Subtasks: No Subtasks

Abstract Code

Heating/Cooling details Report is selected:

- Display heating and cooling details
- Grouping is done based on household types.
  - Show count air conditioners, average A/C BTU, average EER in column
  - Show count heaters, average heater BTU, most common energy source in column
  - Show count of heat pumps, average heat pump BTU, average SEER, average HSPF in column
- Aggregation operation is done to collect the data from database.

Get Water Heater Statistics by State

Task Decomposition

Lock Types: Lookup Postal Code, Lookup Appliance, Look up Household Information
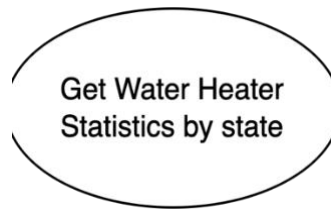
Number of Locks: 1

Enabling Conditions: By User selecting Get Water Heater Statistics Report from View Reports page

Frequency: Around 100 times/day

Consistency (ACID): Not Crucial

Subtasks: No Subtask Required

Mother Task: Not Required

Get Water Heater
Statistics by state

Abstract Code

Water Heater Statistics by State Report is selected:

– Input form to enter the state and validate the state. With drop down list for all the states.
– Hyperlink to provide for respective drill down on statistics with previous and next button to navigate between reports.

Get Off-The-Grid Household Dashboard

Task Decomposition

Lock Types: Get State with most off-the-grid households, Get BTU statistics for off-the-grid household, Get off-the-grid power generation type, Get Water heater gallon capacity for all the gid and on-the-grid for all states Power Generation information, Get Average battery storage capacity for all states.
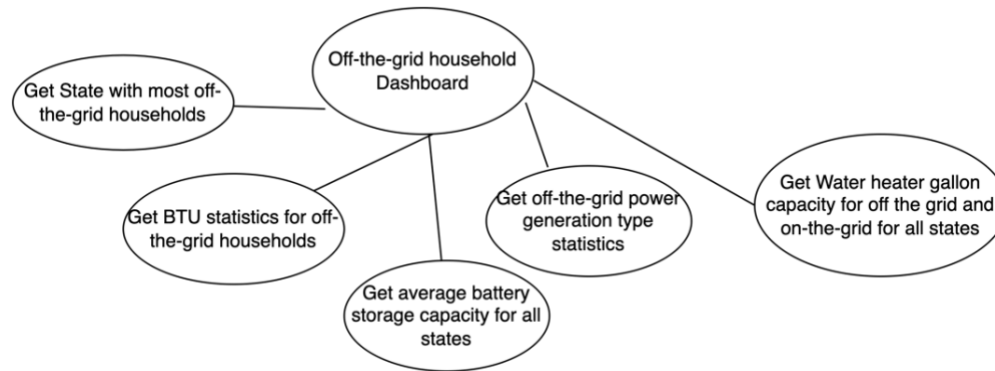
Number of Locks: 5

Enabling Conditions: By User selecting Off-The-Grid Household Dashboard from View Reports page

Frequency: Around 100 times/day

Consistency (ACID): Not Crucial

Subtasks: Get State with most off-the-grid households, Get BTU statistics for off-the-grid household, Get off-the-grid power generation type, Get Water heater gallon capacity for all the gid and on-the-grid for all states Power Generation information, Get Average battery storage capacity for all states.

Mother Task will be required.

Abstract Code

Off-the grid household dashboard Report is selected, users gets multiple report in tabular form:

− List state with most off-the-grid households are listed in tabular form along with count of its household.

− Get data for all off-the-grid households, the average battery storage capacity (as a whole number, rounded) and display on table

− Get data for all off-the-grid households, the percentages (as decimal numbers, rounded to tenths) for each power generation type (solar-electric, wind, or mixed) and display

− Get average water heater gallon capacity for off-grid house, and on-grid houses for all state and display it to a table

− Get the minimum, average and maximum (as whole numbers, rounded) BTUs for all off-the- grid households' appliances and display along with the appliance type

Get Household Averages by Radius

Task Decomposition

Lock Types: get valid all postal code within range, get household information and filter for postal code
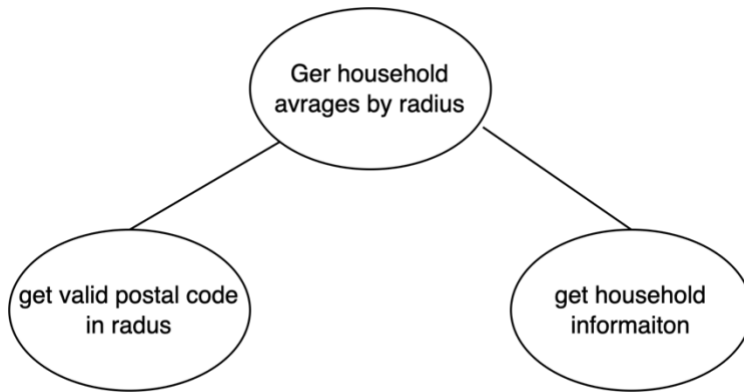
Number of Locks: 2

Enabling Conditions: By User selecting Household Averages by Radius from View Reports page

Frequency: Around 100 times/day

Consistency (ACID):

Subtasks: get postal code in radius, get household information

Abstract Code

Household averages by Radius Report is selected:

- This report takes two inputs
- First input whole number, validation to check number is whole number for the radius
- Second input is for postal codes
- When User click to find or display report, validation happens to check if postal code is valid or not valid i.e., exists or does not exist in system. It will display the household average for the given input of postal code and given radius, for zero radius it displays only for the selected postal code.
- Reports will generate and display in tabular form with details on

    - the count of households
    - the count of households for each household type (displaying 0 if there are none for that type)
    - average square footage (as a whole number, rounded)
    - the average heating temperature (as a decimal number rounded to tenths)
    - the average cooling temperature (as a decimal number rounded to tenths)
    - which public utilities are used (displayed in a single cell, separated by commas)
    - the count of "off-the-grid" homes, the count of homes with power