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Demonstration of HEEP

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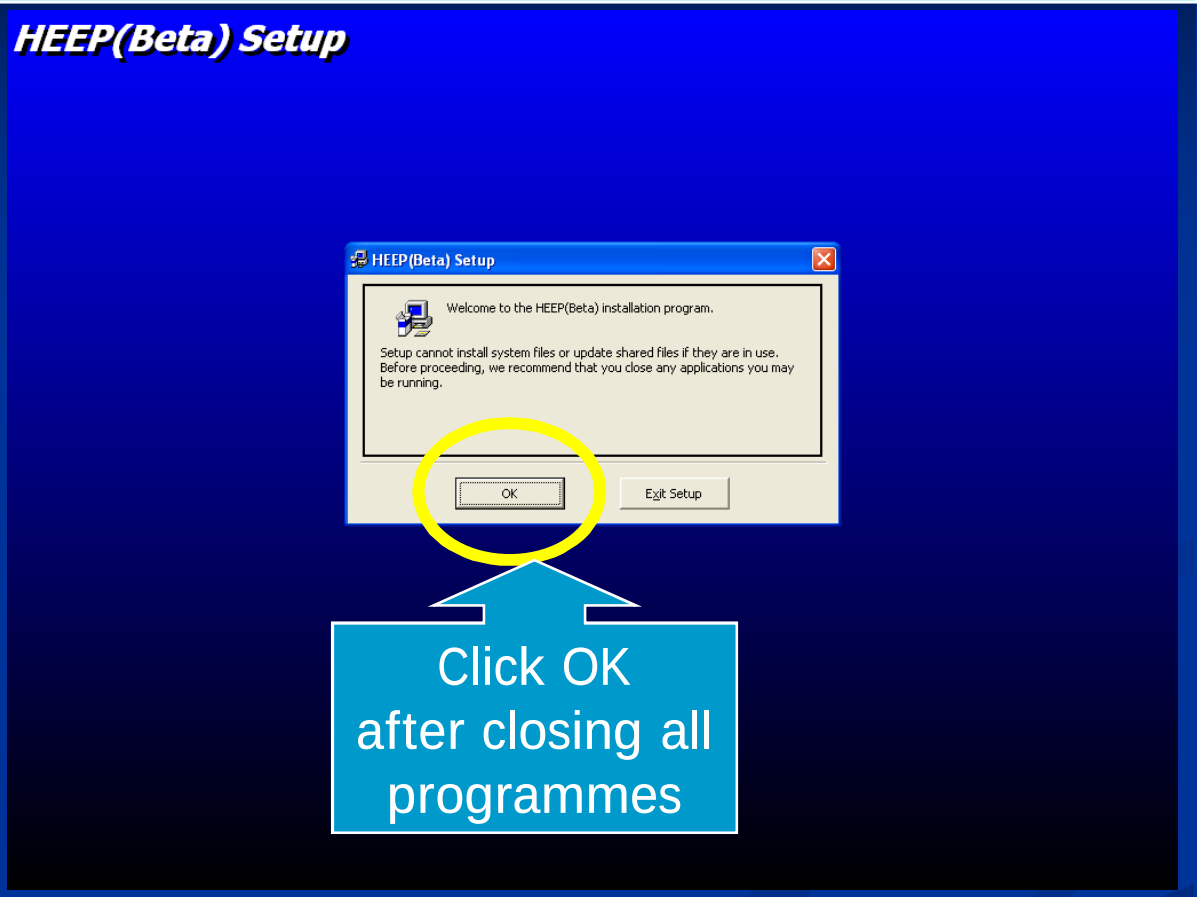
Outline of the demonstration of HEEP

- Installation of HEEP
- Use of manuals
- Using the programme
- General guidelines for entering/editing data
- Demonstration of HEEP
  - Description of the case being demonstrated

Installation of HEEP

Steps to install HEEP (1/3)

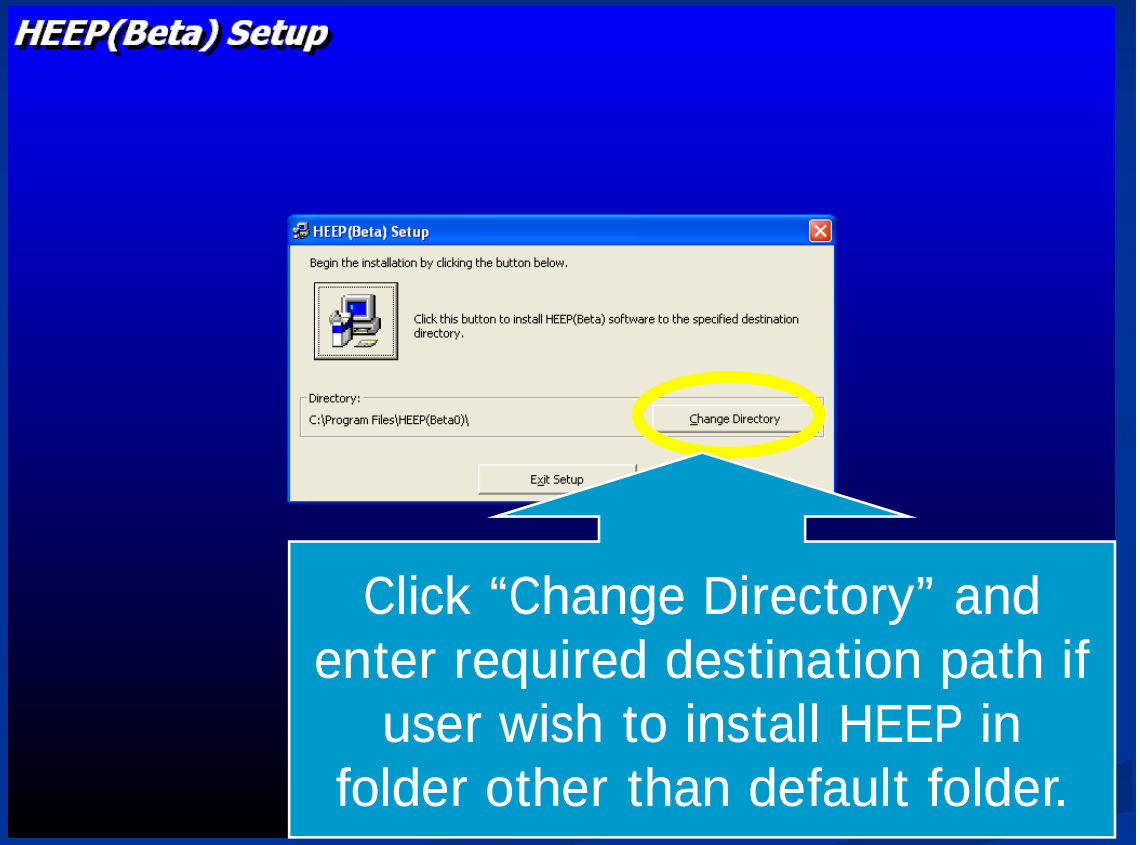
- Request IAEA for HEEP
- Download file from IAEA website
- Unzip the file
- Run “setup.exe” from unzipped file.
- Setup will prompt to close all running programmes.



- Press Alt+Tab to switch to running programmes.
- Switch to running programmes and close them all.

Steps to install HEEP (2/3)

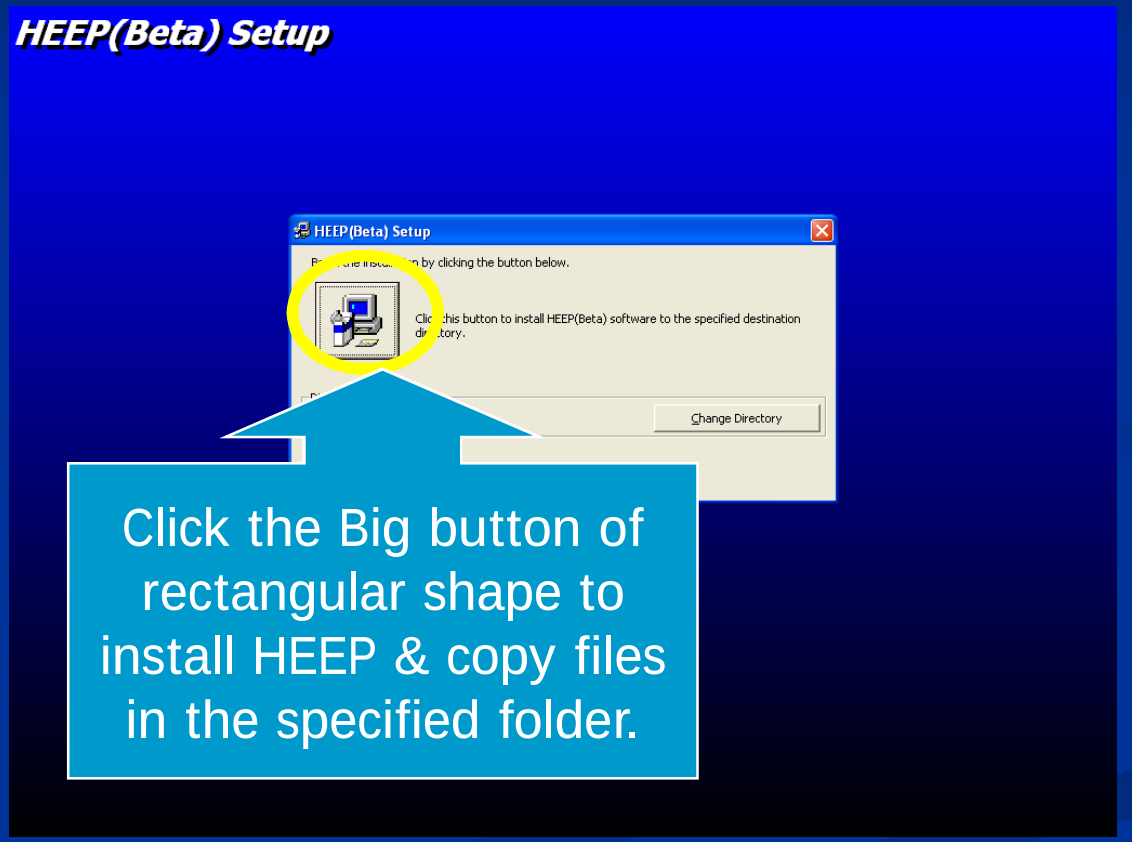
- Programme will be installed in a default folder "C:\Programme Files\HEEP(Beta0)\"
- User may choose to install in the folder other than the default folder.



- Set-up will prompt to accept or deny creation of folder. Click "yes" to create folder.

Steps to install HEEP (3/3)

- All files required for running HEEP and manuals will be copied to respective destinations.
  - Manuals are copied to the subfolder “Manuals” in the destination folder entered earlier.

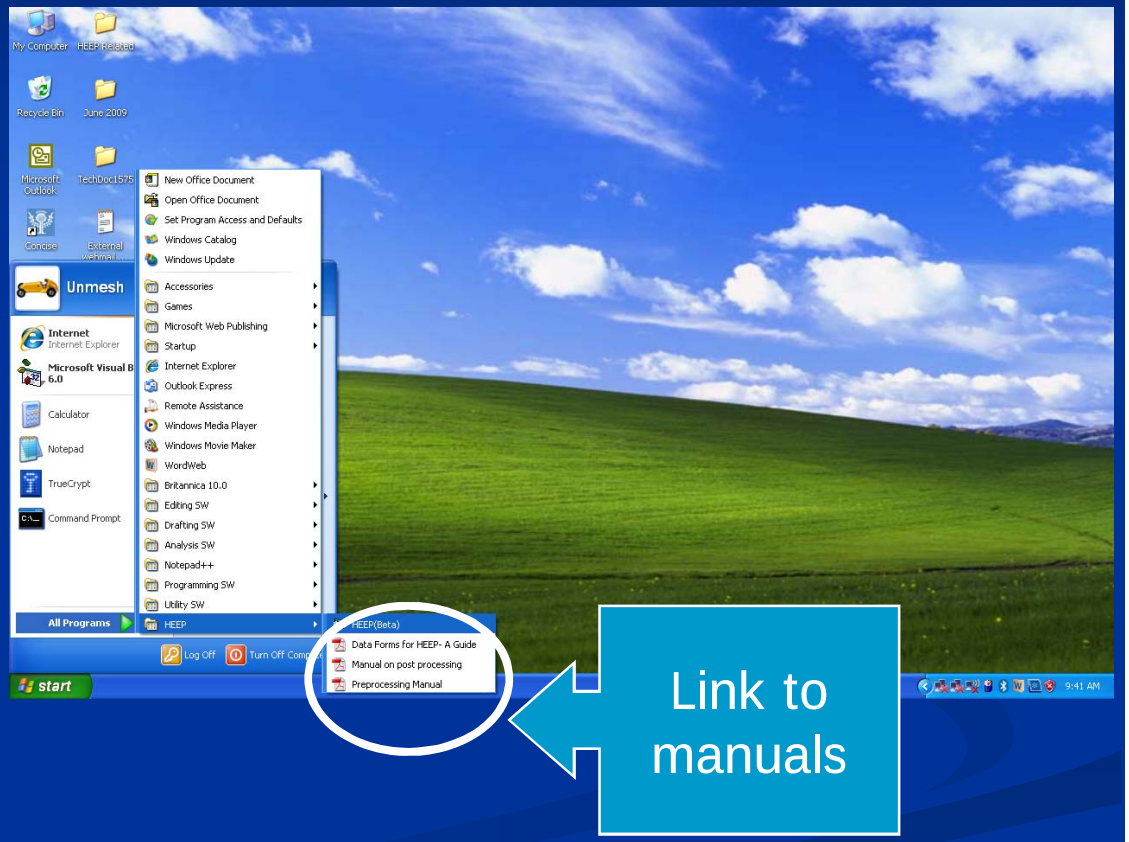


- Installation creates HEEP(Beta0) at the location specified during installation and also creates following folders within HEEP(Beta0)
  - CaseFile
  - DataBase
  - EXEMODULE
  - POST
- All permissions (read, write, modify etc.) for all folders created in HEEP needs to be set for OS users
- For Windows-7- needs to set the programme attribute as “run as administrator” or “run in compatibility mode”

Manuals

List of manuals

- Preprocessor manual
  - Formats for data to be collected for HEEP
- Manual for execution engine
- Manual for post processing



Manuals are in pdf form.

Contents of the pre-processing manual

- First two chapters:
  - Procedures to start using the programme
  - Options of estimating cost of hydrogen
    - Building new case
    - Read existing case
  - Information on important steps to be followed
- Third chapter:
  - Important general procedures
    - Entering the data and viewing and/or editing already entered details
    - Storing the data
    - Updating the database
    - Some important tips
- Fourth chapter:
  - Procedure for building new case
- Fifth chapter:
  - Details of information required for cost estimation using HEEP.

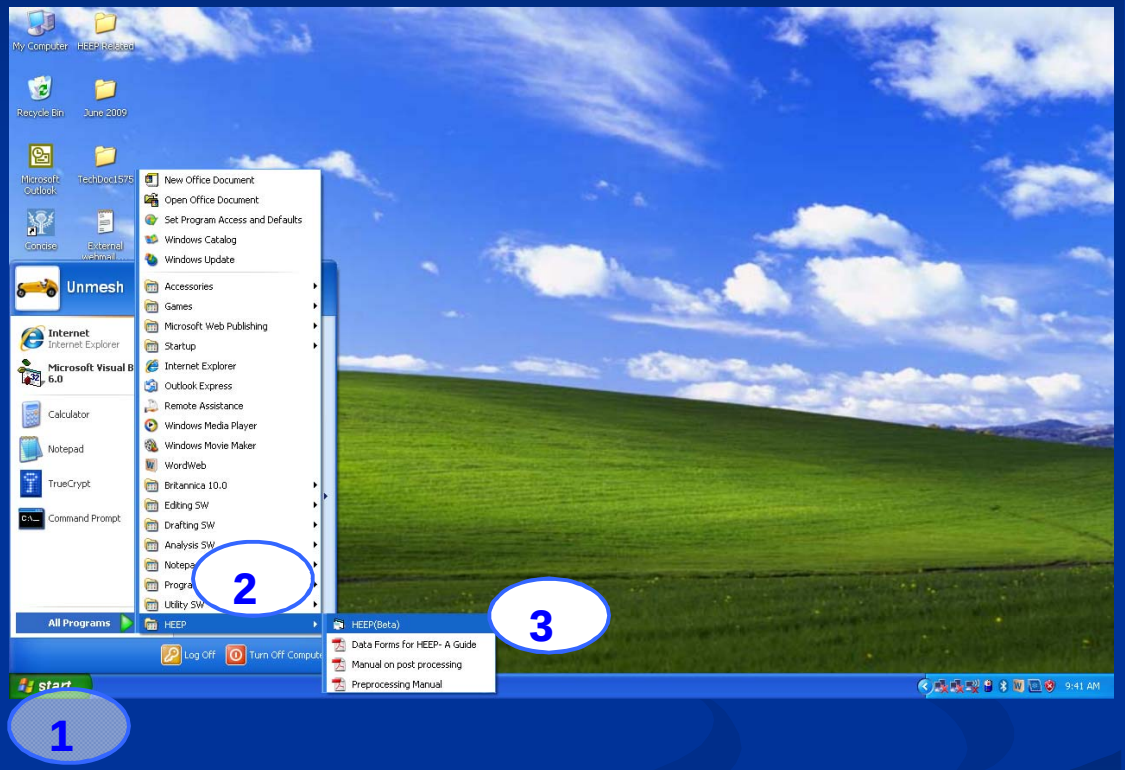
Important fonts used in the pre-processing manual

- Text with ***'bold-italic'*** font indicates actions to be taken by the user.

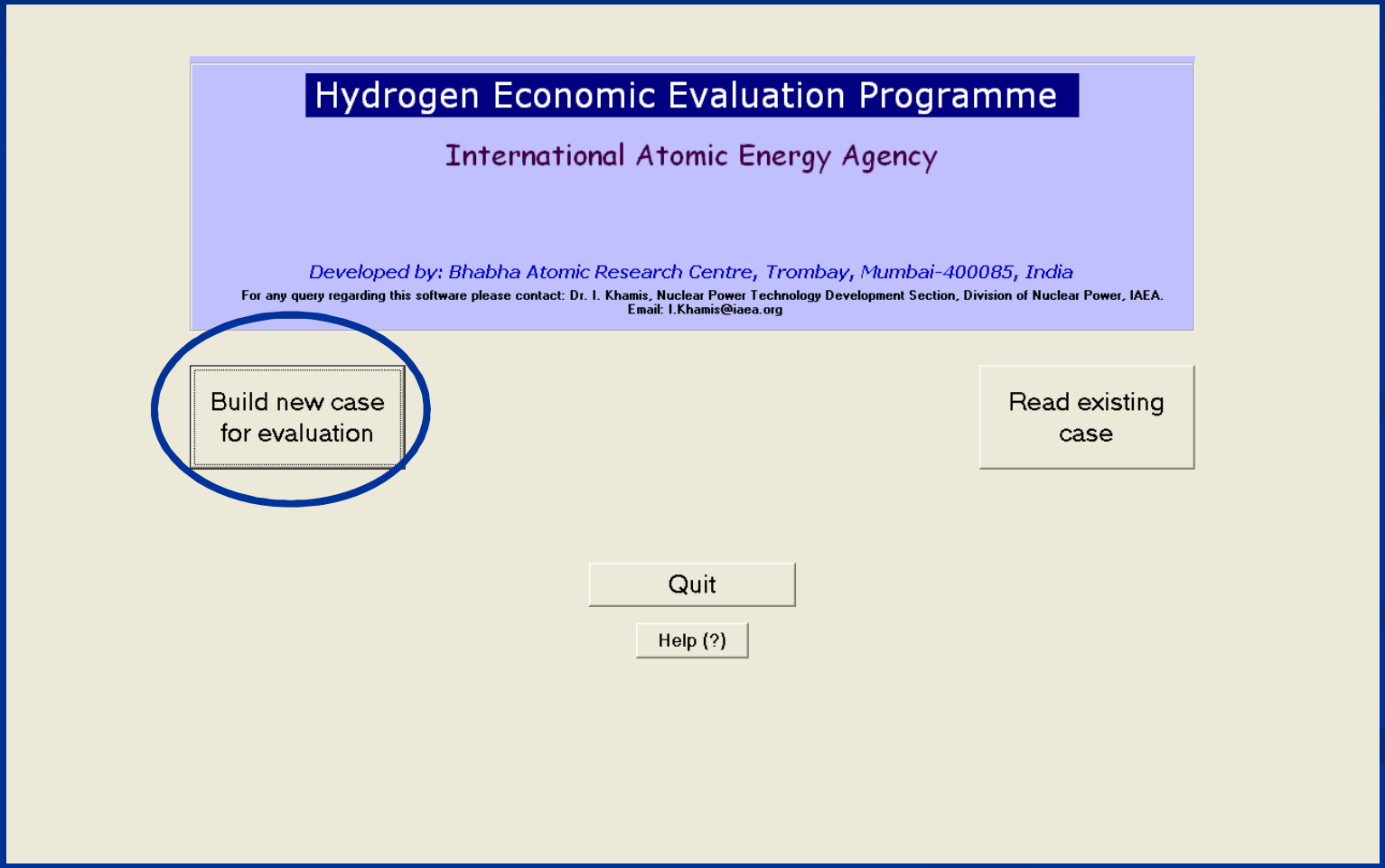
- Text in the *'italic'* font gives important information to the user

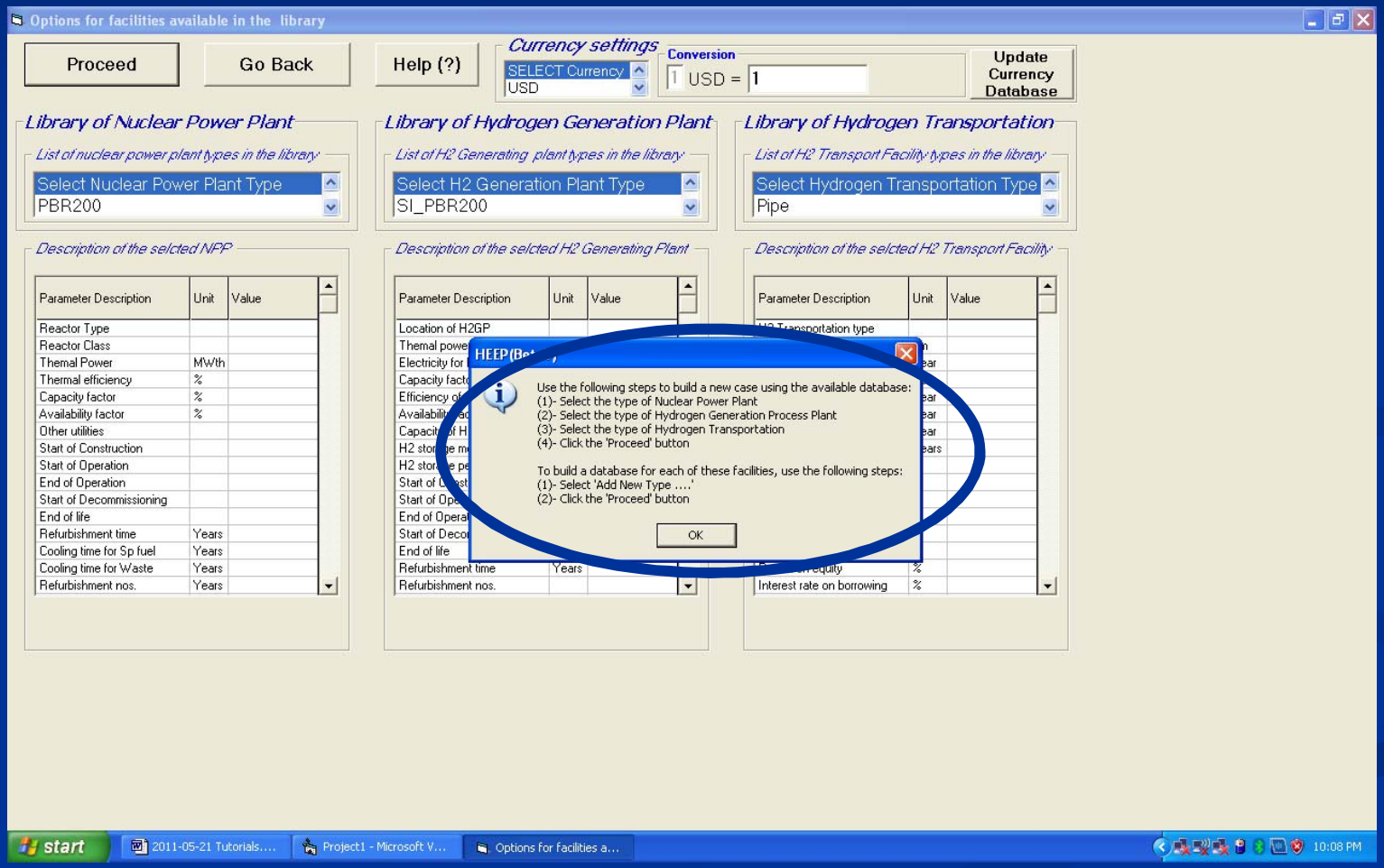
Starting the programme

1. Click “Start”
2. Click “HEEP”
3. Click “HEEP(Beta)”



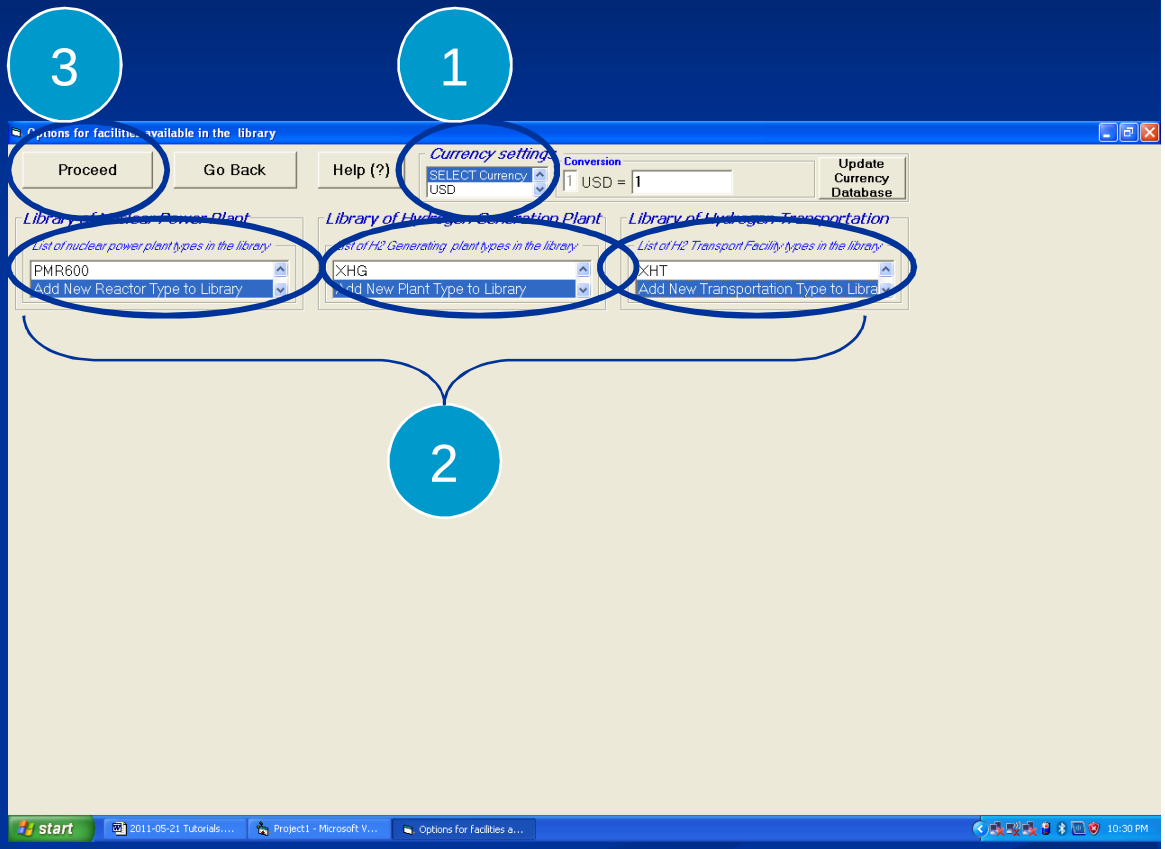
Building the new case




Options for facilities available in the library
Proceed
Go Back
Help (?)
Currency settings
SELECT Currency
USD
Conversion
1 USD = 1
Update Currency Database
Library of Nuclear Power Plant
List of nuclear power plant types in the library
Select Nuclear Power Plant Type
PBR200
Library of Hydrogen Generation Plant
List of H2 Generating plant types in the library
Select H2 Generation Plant Type
SI_PBR200
Library of Hydrogen Transportation
List of H2 Transport Facility types in the library
Select Hydrogen Transportation Type
Pipe
Description of the selcted NPP
Parameter Description
Unit
Value
Reactor Type
Reactor Class
Thermal Power
MWth
Thermal efficiency
%
Capacity factor
%
Availability factor
%
Other utilities
Start of Construction
Start of Operation
End of Operation
Start of Decommissioning
End of life
Refurbishment time
Years
Cooling time for Sp fuel
Years
Cooling time for Waste
Years
Refurbishment nos.
Years
Description of the selcted H2 Generating Plant
Parameter Description
Unit
Value
Location of H2GP
Refurbishment time
Years
Refurbishment nos.
Description of the selcted H2 Transport Facility
Parameter Description
Unit
Value
Interest rate on borrowing
%
HEEP(Be
Use the following steps to build a new case using the available database:
(1)- Select the type of Nuclear Power Plant
(2)- Select the type of Hydrogen Generation Process Plant
(3)- Select the type of Hydrogen Transportation
(4)- Click the 'Proceed' button
To build a database for each of these facilities, use the following steps:
(1)- Select 'Add New Type ....'
(2)- Click the 'Proceed' button
OK
start
2011-05-21 Tutorials....
Project1 - Microsoft V...
Options for facilities a...
10:08 PM

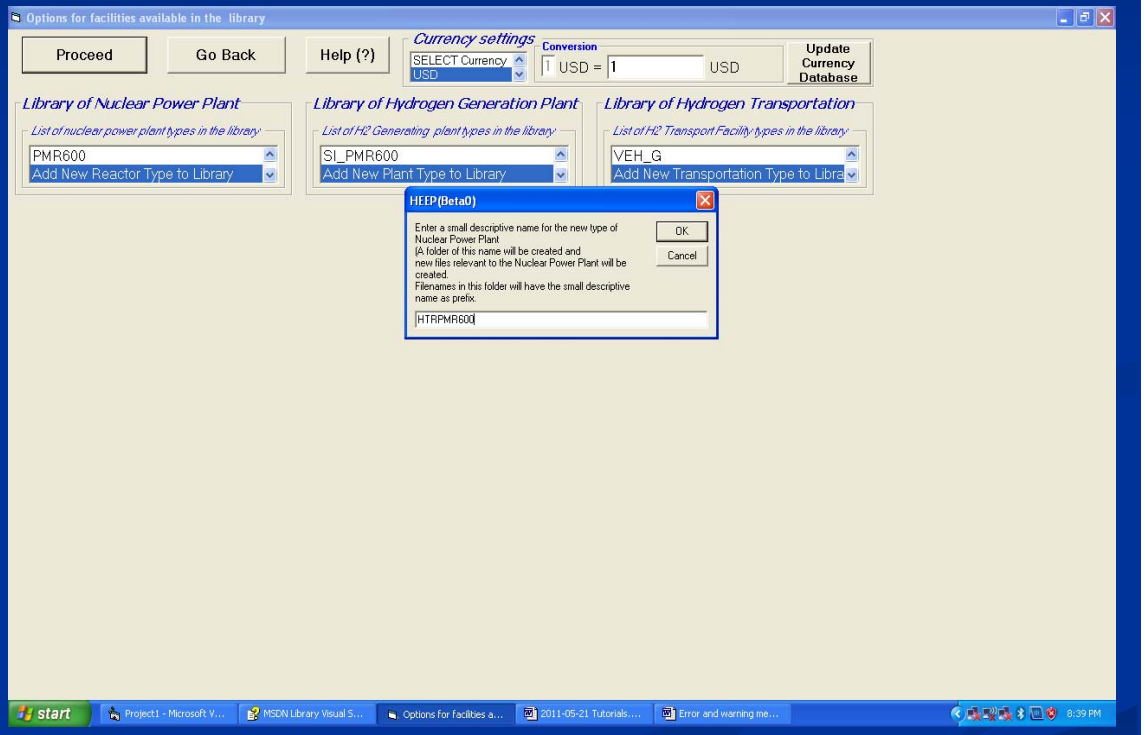
Adding new database

1. Select the currency
2. Select "Add New Reactor Type to Library", "Add New Plant Type to Library" and "Add New Transportation Type to Library" for the three facilities.
3. Click "Proceed"

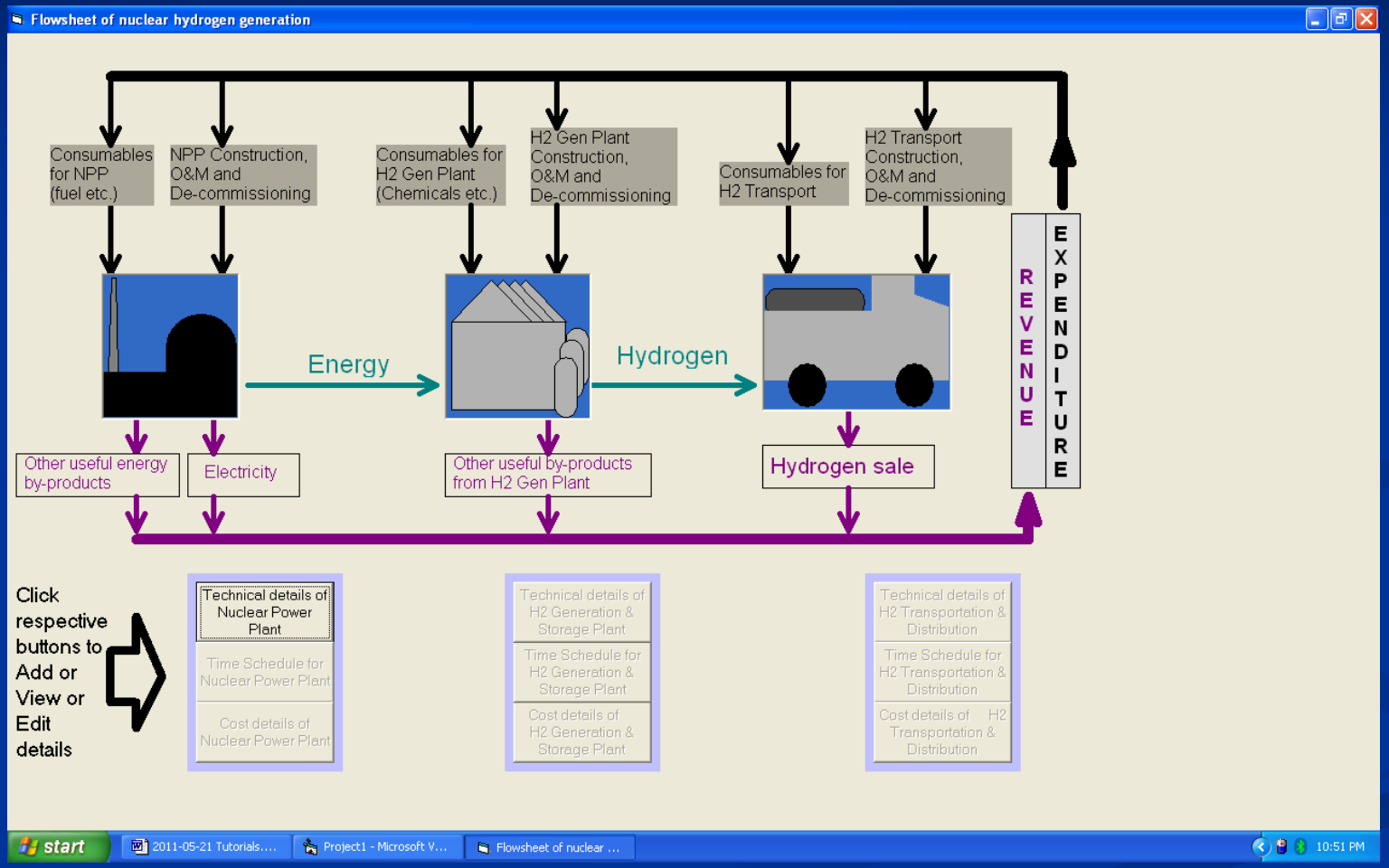


Entering names of database

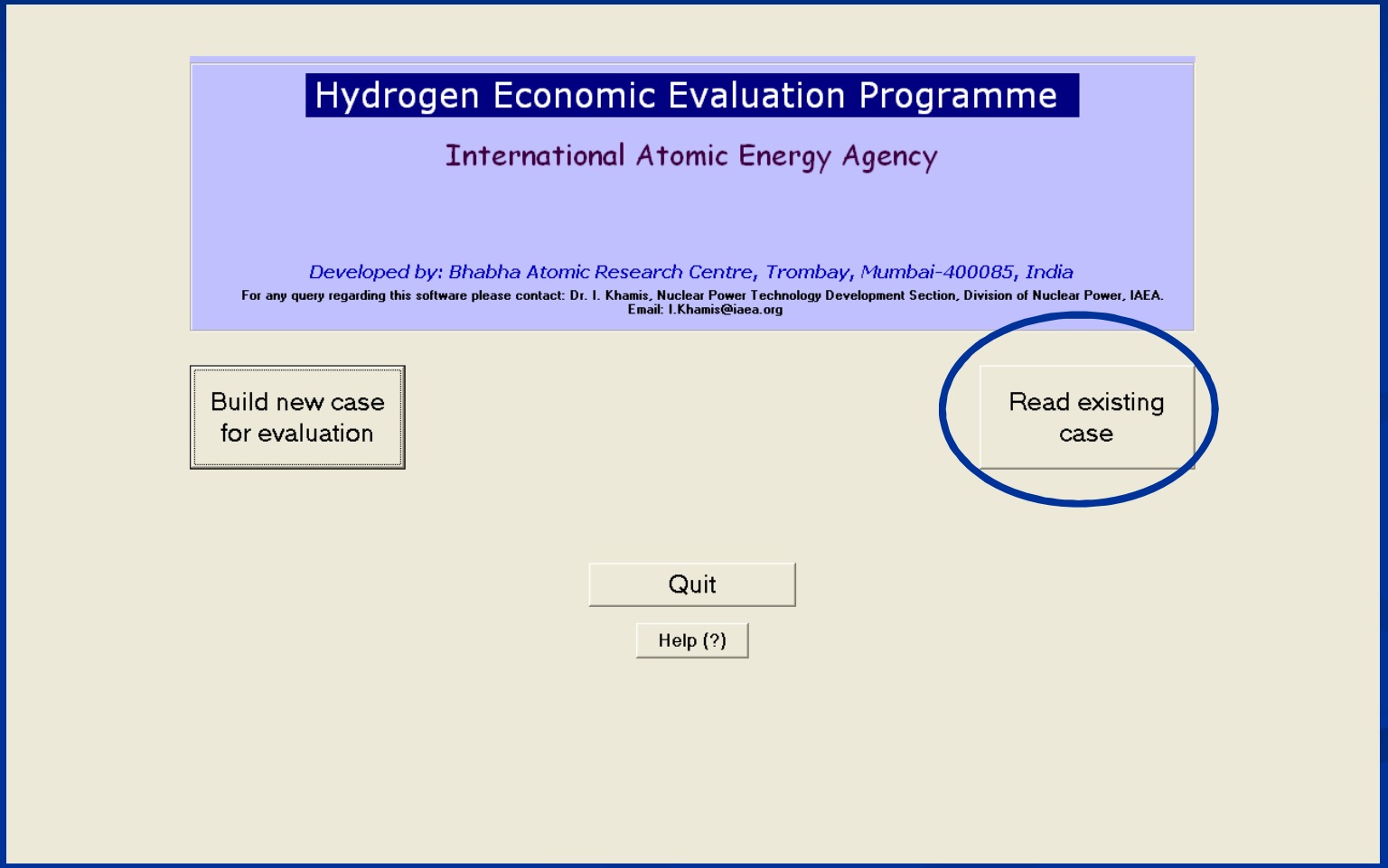
- Enter name of new database for nuclear power plant and click “OK”
- Enter name of new database for hydrogen generation plant and click “OK”
- Enter name of new database for hydrogen transportation and click “OK”

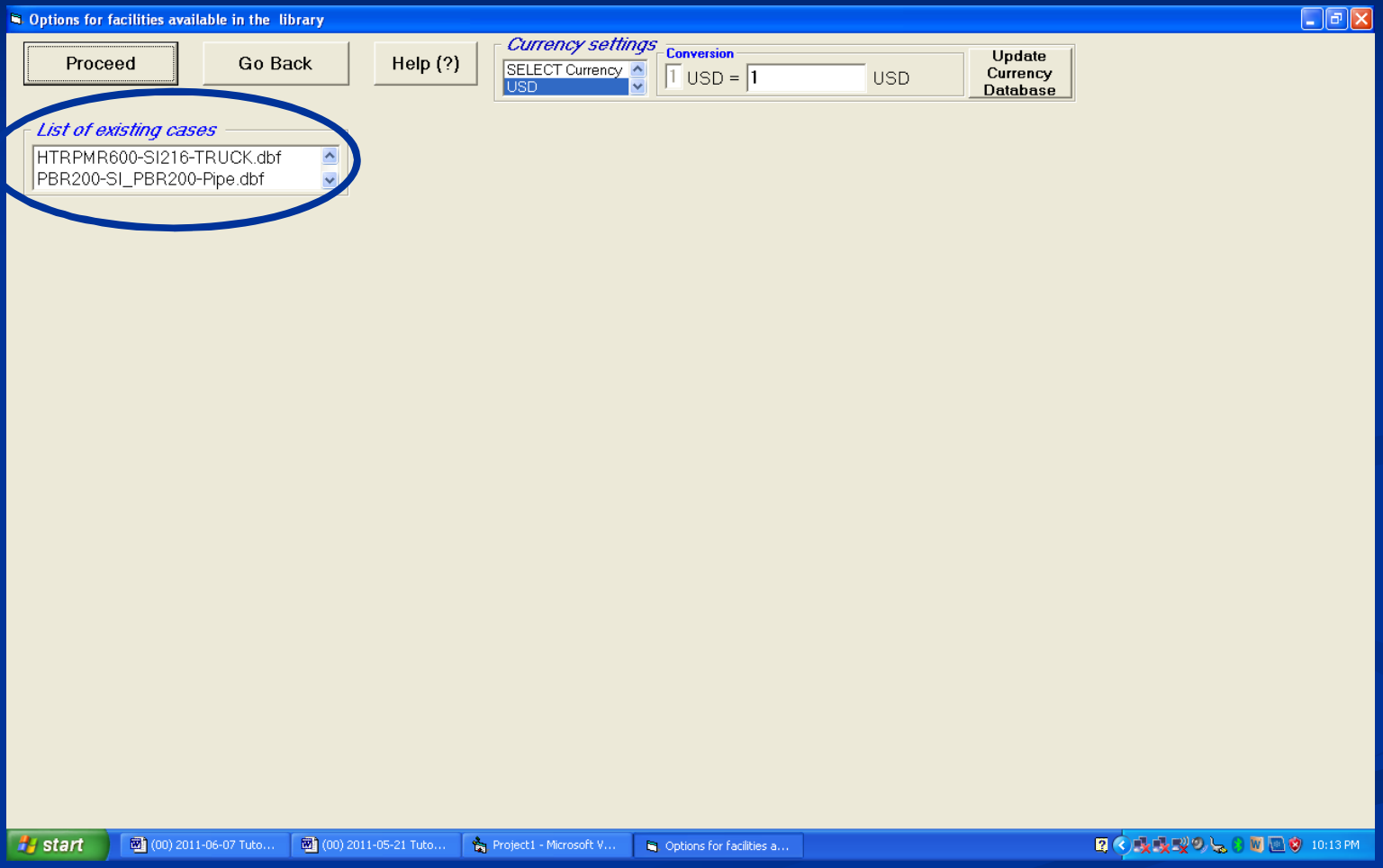


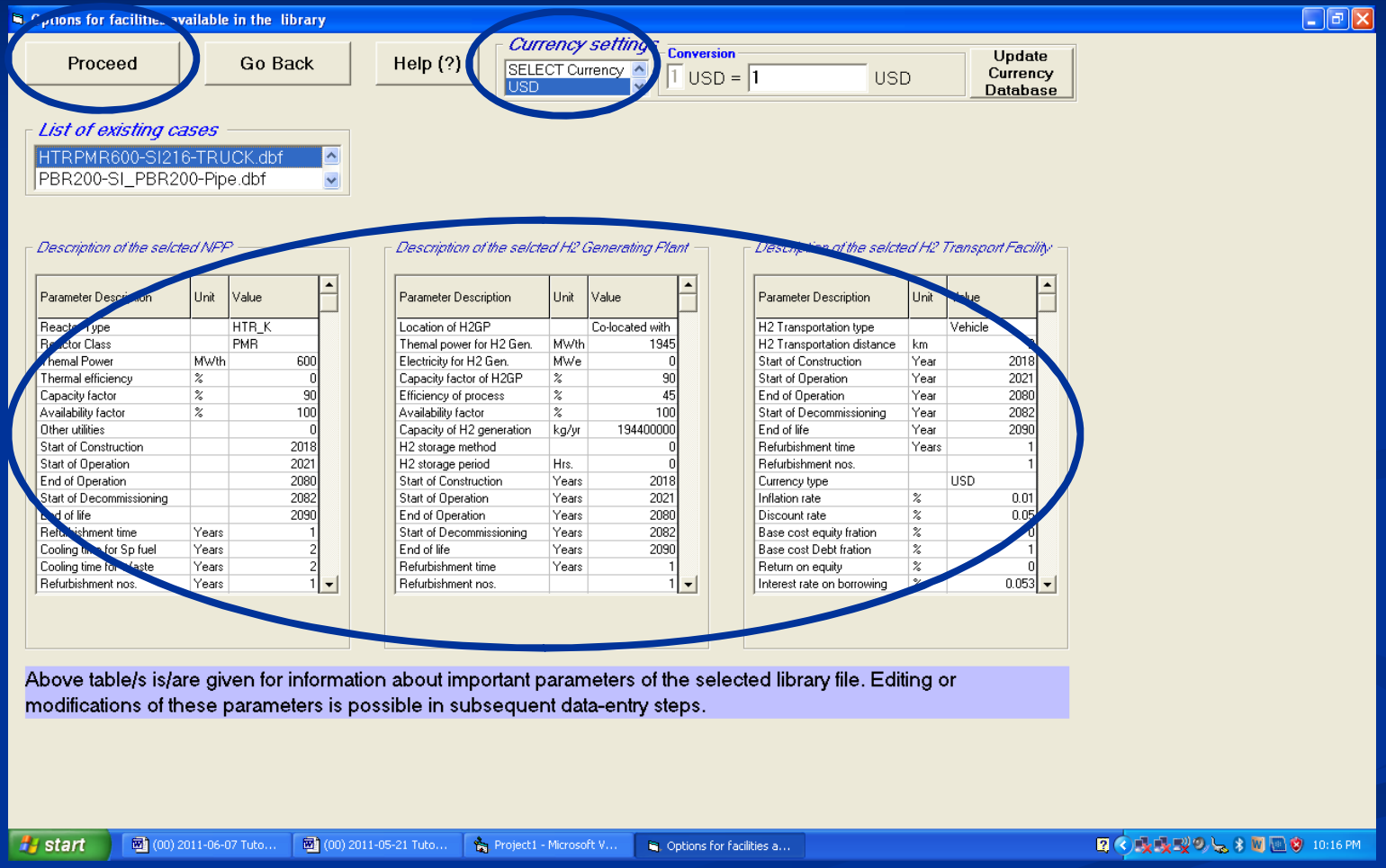
Start entering data



Read Existing Case




Options for facilities available in the library
Proceed
Go Back
Help (?)
Currency settings
SELECT Currency
USD
Conversion
1 USD = 1 USD
Update Currency Database
List of existing cases
HTRPMR600-SI216-TRUCK.dbf
PBR200-SI_PBR200-Pipe.dbf
start
(00) 2011-06-07 Tuto...
(00) 2011-05-21 Tuto...
Project1 - Microsoft V...
Options for facilities a...
10:13 PM



Parameter Description	Unit	Value
Reactor type		HTR_K
Reactor Class		PMR
Thermal Power	MWth	600
Thermal efficiency	%	0
Capacity factor	%	90
Availability factor	%	100
Other utilities		0
Start of Construction		2018
Start of Operation		2021
End of Operation		2080
Start of Decommissioning		2082
End of life		2090
Refurbishment time	Years	1
Cooling time for Sp fuel	Years	2
Cooling time for Waste	Years	2
Refurbishment nos.	Years	1

Parameter Description	Unit	Value
Location of H2GP		Co-located with
Thermal power for H2 Gen.	MWth	1945
Electricity for H2 Gen.	MWe	0
Capacity factor of H2GP	%	90
Efficiency of process	%	45
Availability factor	%	100
Capacity of H2 generation	kg/yr	194400000
H2 storage method		0
H2 storage period	Hrs.	0
Start of Construction	Years	2018
Start of Operation	Years	2021
End of Operation	Years	2080
Start of Decommissioning	Years	2082
End of life	Years	2090
Refurbishment time	Years	1
Refurbishment nos.		1

Parameter Description	Unit	Value
H2 Transportation type		Vehicle
H2 Transportation distance	km	
Start of Construction	Year	2018
Start of Operation	Year	2021
End of Operation	Year	2080
Start of Decommissioning	Year	2082
End of life	Year	2090
Refurbishment time	Years	1
Refurbishment nos.		1
Currency type		USD
Inflation rate	%	0.01
Discount rate	%	0.05
Base cost equity fration	%	0
Base cost Debt fration	%	1
Return on equity	%	0
Interest rate on borrowing	%	0.053

Categorisation of input information for HEEP

Facilties	Categories of input parameters
Nuclear power plant	Technical parameters
	Chronological data
	Cost elements
Hydrogen generation and storage plant	Technical parameters
	Chronological data
	Cost elements
Hydrogen transportation facility	Technical parameters
	Chronological data
	Cost elements

Technical details of Nuclear power plant

- Number of units
- Rated installed capacity per unit
- Capacity factor of unit
- Availability factor of unit
- Thermal power available for hydrogen generation
- Thermal efficiency of unit (if electricity is generated)

Technical details of hydrogen generation plant

- Location of plant (Co-located with NPP or isolated)
- Number of units
- Rated annual hydrogen generation rate
- Process efficiency
- Capacity factor of unit
- Availability factor of unit
- Maximum thermal power required for process by each unit
- Maximum electricity required for process by each unit
- Non-process electricity required by each unit

Technical details of hydrogen storage facility

- Type of hydrogen storage
  - Gaseous
  - Liquid
  - Metal hydride
- Storage equipment capacities
  - Storage time
- Power requirements of storage devices
- Auxiliary requirements of storage devices
  - Rate of cooling water for storage compressor

Technical details of hydrogen transportation facility

- Type of hydrogen transportation
  - Pipeline
  - Vehicle
- For pipeline transportation
  - Transportation distance
  - Technical parameters affecting power required to overcome losses in pipeline transportation
- For vehicular transportation
  - Transportation distance
  - Mileage of vehicle
  - Vehicle capacity
  - Speed of vehicle
  - Preparation time for each trip of the vehicle

Capital cost inputs

Quick inputs	Detailed inputs (Two levels)

■ Nuclear power plant
  ■ Specific cost
■ Hydrogen generation and storage plant
  ■ Capital cost of hydrogen generation plant
  ■ Parameters for quick estimates of capital cost for hydrogen storage
■ Hydrogen transportation
  ■ Pipeline transport
  ■Compressor cost
  ■Pipe cost
  ■ Vehicle transport
  ■Cost of one vehicle
	Cost of activities sub-divided in to two levels of code of account.
	
	Example:
	■ Civil structures and buildings
	  ■ Reactor building cost
	  ■ Fuel building cost
	  ■ etc.
	■ Bunsen rector cost
	  ■ Reactor vessel
	  ■ Piping
	  ■ etc.

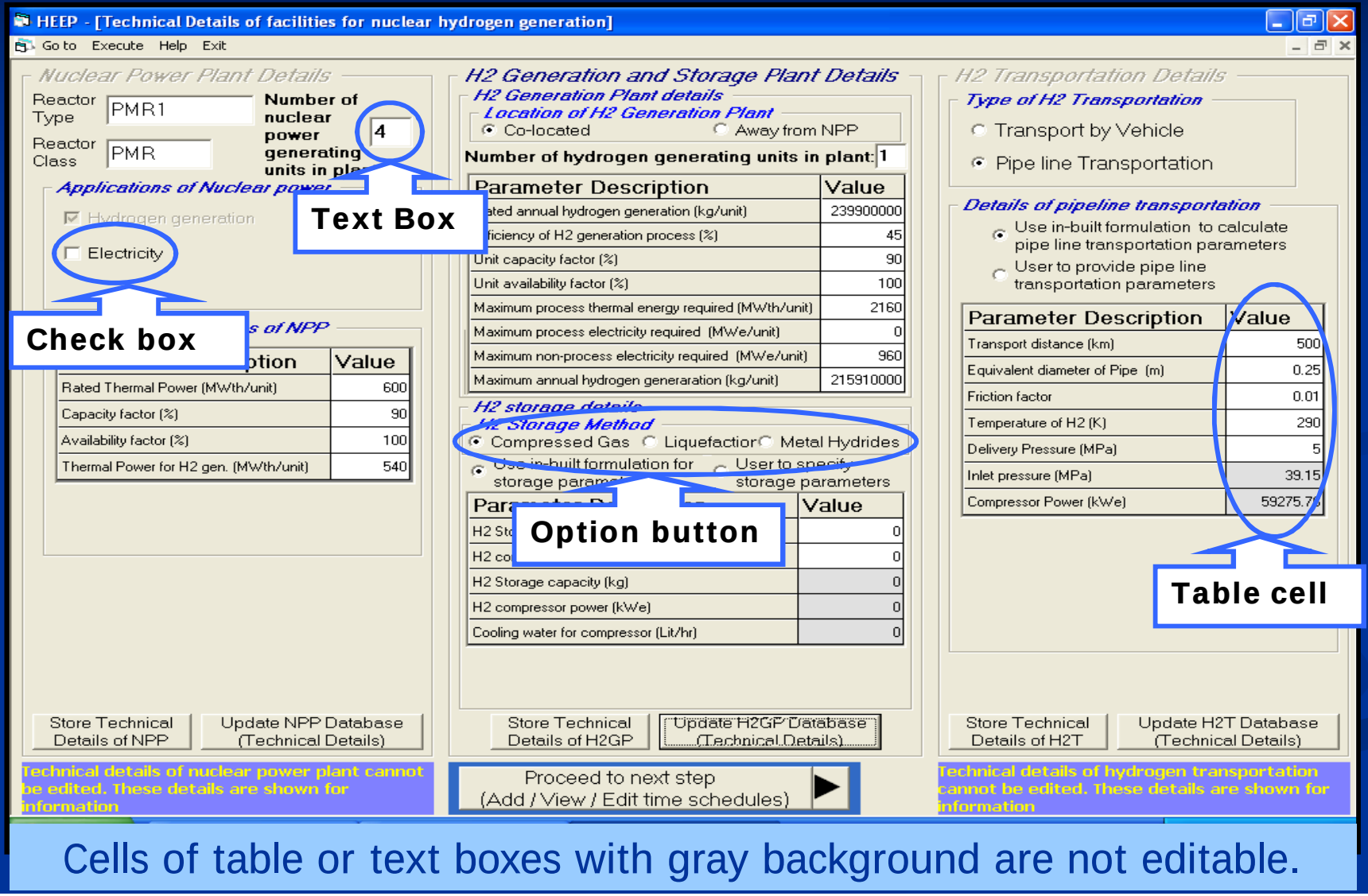
O&M cost inputs

Quick inputs	Detailed inputs (Two levels)

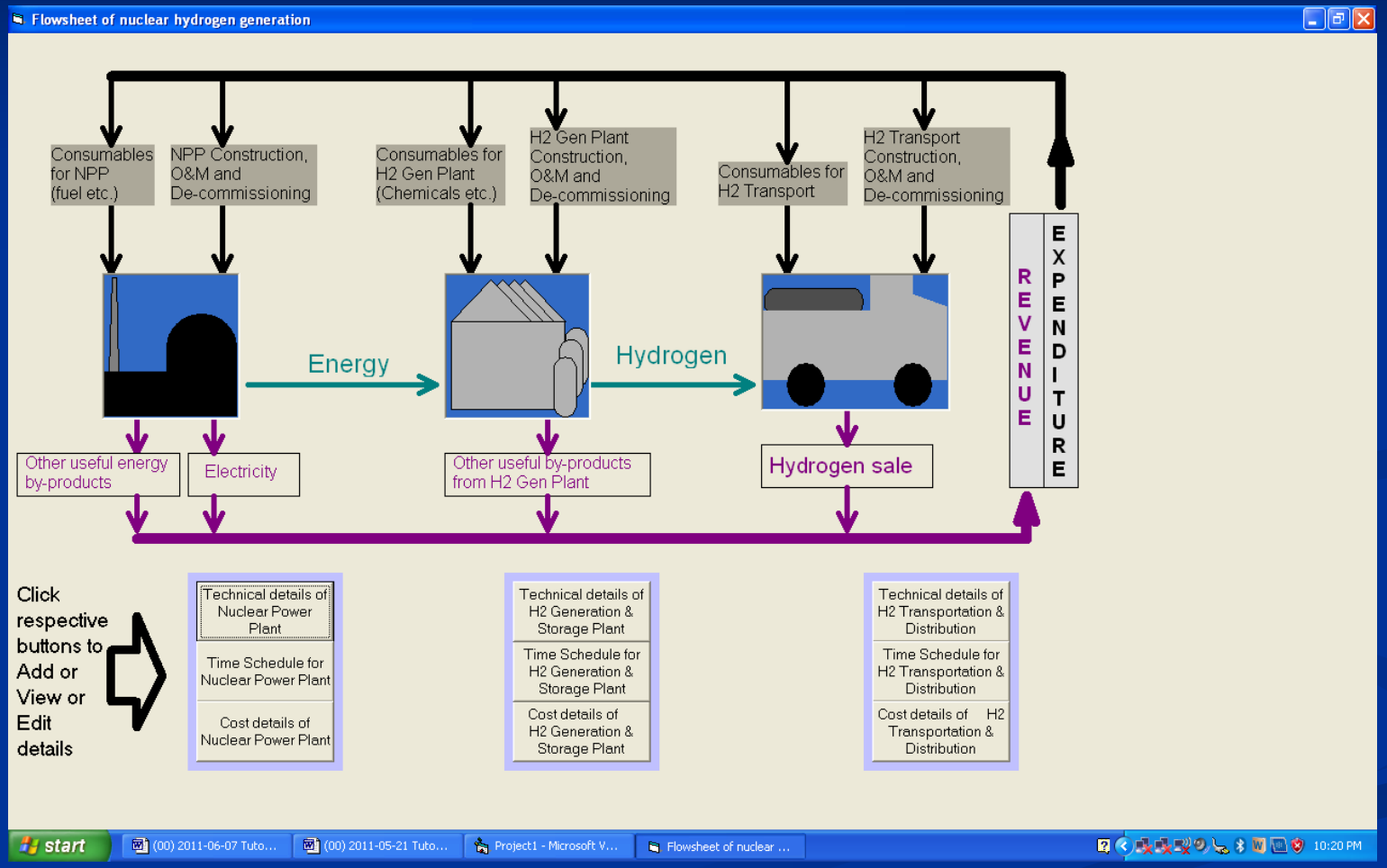
■ Nuclear power plant
  ■ O&M cost as % of capital cost
■ Hydrogen generation and storage plant
  ■ Maintenance cost as % of capital cost
  ■ Operating cost
  ■Electricity
  ■Cooling water charges
■ Hydrogen transportation
  ■ Pipeline transport
  ■Electricity
  ■Compressor cooling
  ■ Vehicle transport
  ■Driver's wages, Fuel charges
	Cost of activities sub-divided in to two levels of code of account for each year
	
	Example:
	■Labor cost
	■Operating cost
	  ■ Electricity charges
	  ■ Salaries

General guidelines for entering/editing data

Features for entering/editing information



Cells of table or text boxes with gray background are not editable.


Flowsheet of nuclear hydrogen generation
Consumables for NPP (fuel etc.)
NPP Construction, O&M and De-commissioning
Consumables for H2 Gen Plant (Chemicals etc.)
H2 Gen Plant Construction, O&M and De-commissioning
Consumables for H2 Transport
H2 Transport Construction, O&M and De-commissioning
REVENUE
EXPENDITURE
Energy
Hydrogen
Other useful energy by-products
Electricity
Other useful by-products from H2 Gen Plant
Hydrogen sale
Click respective buttons to Add or View or Edit details
Technical details of Nuclear Power Plant
Time Schedule for Nuclear Power Plant
Cost details of Nuclear Power Plant
Technical details of H2 Generation & Storage Plant
Time Schedule for H2 Generation & Storage Plant
Cost details of H2 Generation & Storage Plant
Technical details of H2 Transportation & Distribution
Time Schedule for H2 Transportation & Distribution
Cost details of H2 Transportation & Distribution
start
(00) 2011-06-07 Tuto...
(00) 2011-05-21 Tuto...
Project1 - Microsoft V...
Flowsheet of nuclear ...
10:20 PM

Editing entering data 1/2

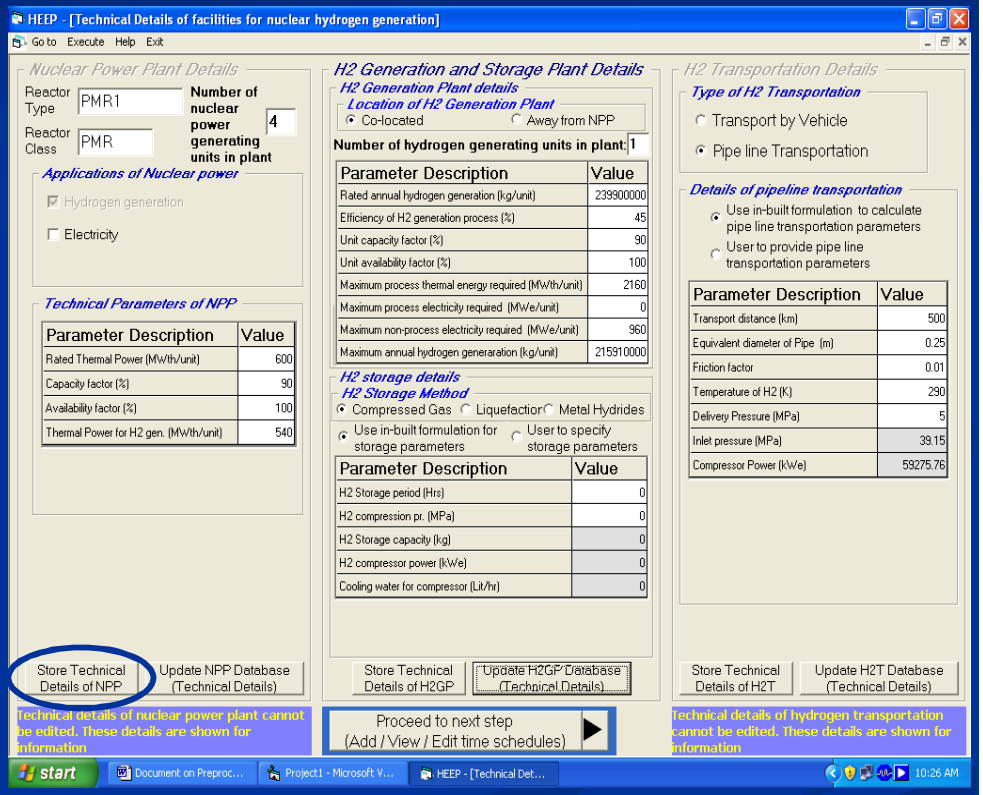
- Option button: allows user to select only one choice among the available list of options
  - Click required option
- Check Box: multiple choices can be selected
  - Click desired choices
- Text Box: to enter numbers or text strings
  - Click the text box and enter required input or edit contents of the text box

Editing entering data 2/2

- Cell of the table: to enter numbers or text strings
  - Click the cell to be edited
  - A text box will appear at cell location along with two buttons “ü” and “X”.
  - Only active text boxes can be edited. (a cursor “|” appears in the text box when it is active). If the test box is not active then click once in the text box.
  - Insert/Edit contents of the text box and click “ü” button to effect the changes made
  - To discard without effecting any changes, click “X” button

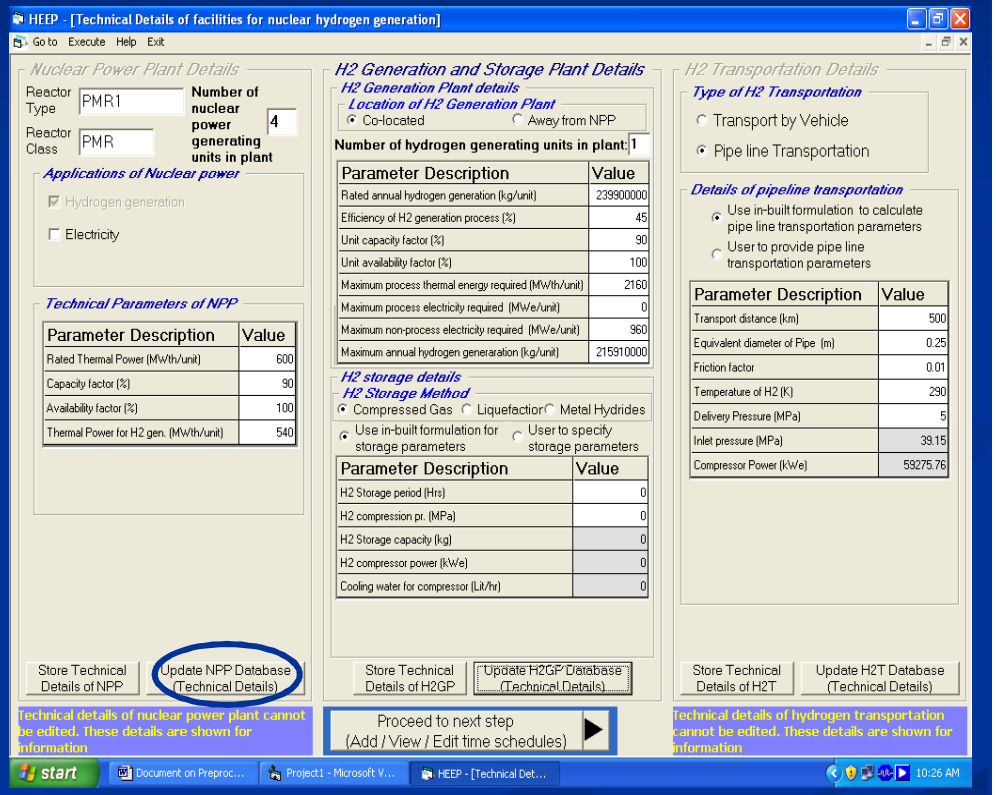
Storing the data

- Storing data
  - Data stored in the memory only. It will be stored till execution of programme is not terminated.
  - Once programme is terminated, user will loose all editing/ modifications made.
- Click command button starting with the word “Store”
- Example: If user wants to store technical details of Nuclear Power Plant then the command button “Store Technical Details of NPP”



Updating database

- Updating database:
  - Implies storing data in library files.
  - If user terminates the programme and user wants to use modified/edited data once again, it can be retrieved the next time programme is used.
- Click command button starting with the word "Update"
- *<u>Example:</u> If user wants to update technical details of Nuclear Power Plant then the command button "Update NPP "*



Demonstration of building new case, modifying data, running the case and viewing results

Case description

- Preliminary benchmarking CASE-I being used as basis
  - Four units of nuclear reactor generates 600 MWth (only heat and no electricity)
  - Electricity for non-process needs of hydrogen generation plant costs 0.06 USD/kWh

- New case:
  - Nuclear reactor equipped to generate electricity
    - Number of units increased to 10
    - Thermal efficiency- 30%
    - Thermal energy to hydrogen generation from each unit- 216 MWth
    - Electricity generation from remaining 384 MWth @30% thermal efficiency
    - Equipment required for electricity generation assumed to increase the capital cost by 10%
    - O&M cost of 1% considered for electricity generating euipments
  - Both plants are co-located

On-line demonstration of HEEP