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Integrated Reservoir Information System in Kamojang, Indonesia

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ABSTRACT

The results from data acquisition and geothermal field monitoring are mostly still in hard copy so are difficult to evaluate and analyze.

Therefore, a computer based information system was built to integrate the textual and numerical system into a graphical information system (map), named “IRIS” the abbreviation of “Integrated Reservoir Information System”. This software runs in the Microsoft Windows environment that can be used easily and is user friendly.

With this system, the user can easily look up any data and information about Kamojang Geothermal Field and do an analysis for a single hole or even a compilation from several holes that results in the dynamic Kamojang reservoir simulation data.

1. INTRODUCTION

The Integrated Reservoir Information System, from a cooperation with Institute Technological of Bandung, was motivated by requirement will integrate data, included reservoir data, production data, geology data and laboratory data. At the time, the data was still spread over many repositories and was mostly in the form of "hard copy" so it was complicate to make a reservoir simulation study.

This system represents information with text, numerical and graphical information based on geographical data (maps). The system was developed using software Delphi, InterBase as engine data base and MapInfo as GIS engine, in Microsoft Windows operating system so that it can be operated easily.

With this system it is easy to store or look for data results of geological surveys, geophysics, geochemistry and monitoring, measurement and well testing of Kamojang field. The combination of data can be integrated for final use to evaluate the Kamojang geothermal systems.

IRIS consists of 11 modules, which are all connected functionally. The modules are: general information, geography, surface manifestation, geology, geochemistry, geophysics, wells, steam field, power plant (in general), integrated analysis reservoir and tools.

Modules 1 to 9 function mostly as storage media for seeking of data and then making simple analysis.

Module 10 is designed to enable the user to analyze data in an integrated manner by using information and data found in modules 1 through 9.

Module 11 (tools) contains conducive software for more detailed user study and can be used to prepare input data for existing reservoir analysis software in the market.

2. INTEGRATED RESERVOIR INFORMATION SYSTEM

Integrated Reservoir Information System consists of 11 modules, which are interconnected with each other (figure 1).

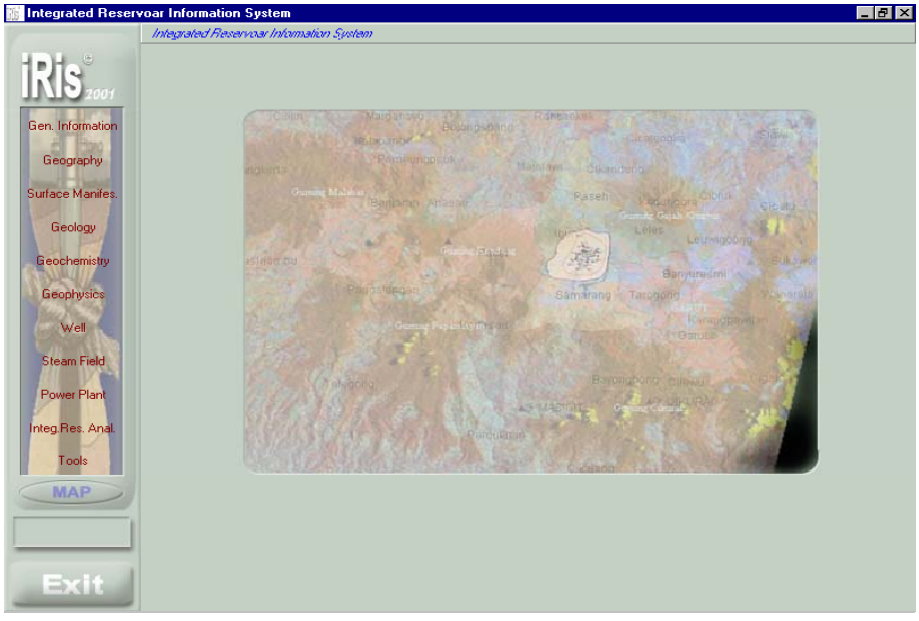

Figure 1: Integrated Reservoir Information System.

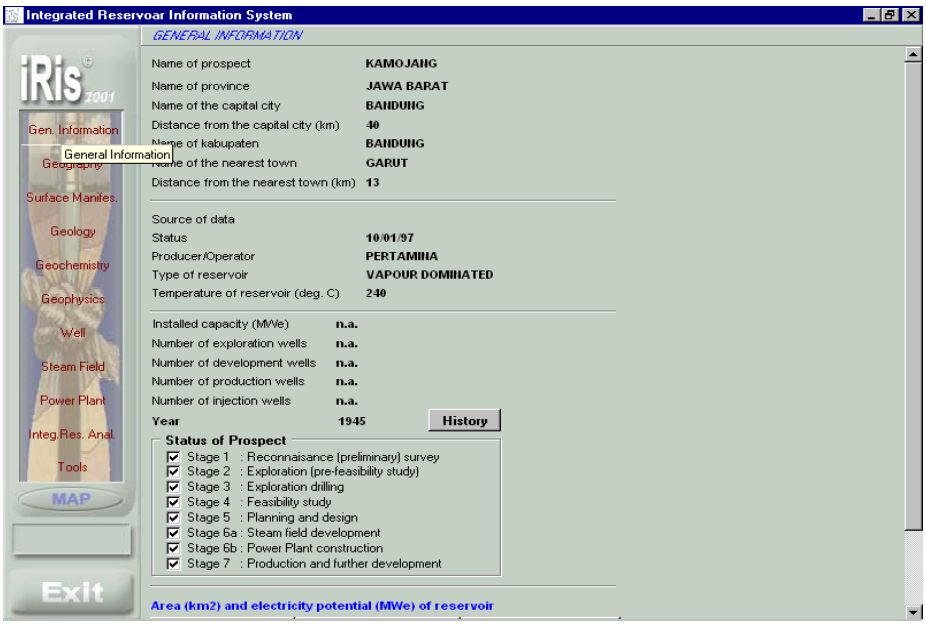

Figure 2: Module-1 General Information.

2.1 Module-1 General Information

This module contains textual information about field location, activity that has been executed in the field, covering: area, reservoir potency (proven, probable and possible), and amount of exploration well, development well and injection wells (Figure 2).

While presented as graphical information in context of the reservoir boundary map and well location, if desired the appearance can be enlarged and minimized according to the desire of the user.

2.2 Module-2 Geography

This module shows geographical information by textual and graphical presentation (Figure 3).

By textual information the software can show farm usage, elevation of each well and atmospheric pressure.

By using MapInfo facilities, the data can be presented in elevation map and maps of farm usage in Kamojang.

2.3 Module-3 Surface Manifestation

In Kamojang geothermal field there are various surface manifestation types, with different characteristics. In this module can be presented by submodules (1) general information, (2) detailed information and (3) photo (Figure 4).

2.4 Module-4 Geology

The Geology module is used for the storage and analysis of the data resulting from geological surveys in field along with results of analysis. The data interpretations are grouped in two forms, that is surface geology and subsurface geology (Figure 5).

The surface geology group informed can be shown graphically in an area map, covering production area, structure, fault and caldera structure.

The surface geology map can present information about protected forest boundary, height of surface of land, ground (elevation), and location boundary with surrounding area.

The subsurface geology module presents in textual and graphical forms, covering: rock lithology, secondary mineral and comparison between secondary minerals and total minerals at various depths.

2.5 Module-5 Geochemistry

Geochemical data is presented in textual and graphical form, in single or multiwell collections, as a function of date or by well (Figure 6).

2.6 Module-6 Geophysics

This module contains only additional information in the form of pictorial results of measurement analysis. This matter is cause by the lack of raw data, which is needed in this system analysis (Figure 7).

2.7 Module-7 Well

The well module is used for the storage and analysis of data resulting from well drilling, data measurement of pressure and temperature logs, and well test data (Figure 8).

Considering the large number of data, this module is dividing into 8 submodules, that is:

Sub module 7.1. **Location**, data kept here are the well co-ordinate on the surface and subsurface from results of survey, which can be presented in two dimensions or three dimensions.

Sub module 7.2. **Casing**, data here is used for the storage and access of information concerning well geometry in multiple or single well form.

Sub module 7.3. **Drilling,** used for the data obtained during drilling, which is grouped into: drilling mud return, drilling rate, circulation lost and mud temperature. Can be presented in multiple and/or single well form.

Sub module 7.4. **Water Loss Test**, prepared for the data of water loss test after drilling.

Sub module 7.5. **Temperature and Pressure,** here is stored data measurement of well temperature and pressure. The data can presented in multiple and/or single well form.

Sub module 7.6. **Production Test,** used for the storage and analysis of data results from production tests. Based on this data, the user can calculate the mass flow rate and fluid enthalpy at various wellhead pressures by using software in the tools module.

Sub module 7.7. **Pressure Build-up Test,** PBU test data place, to analyze in the tools module.

Sub module 7.8. **Photo(s),** place to see facility photos in the field.

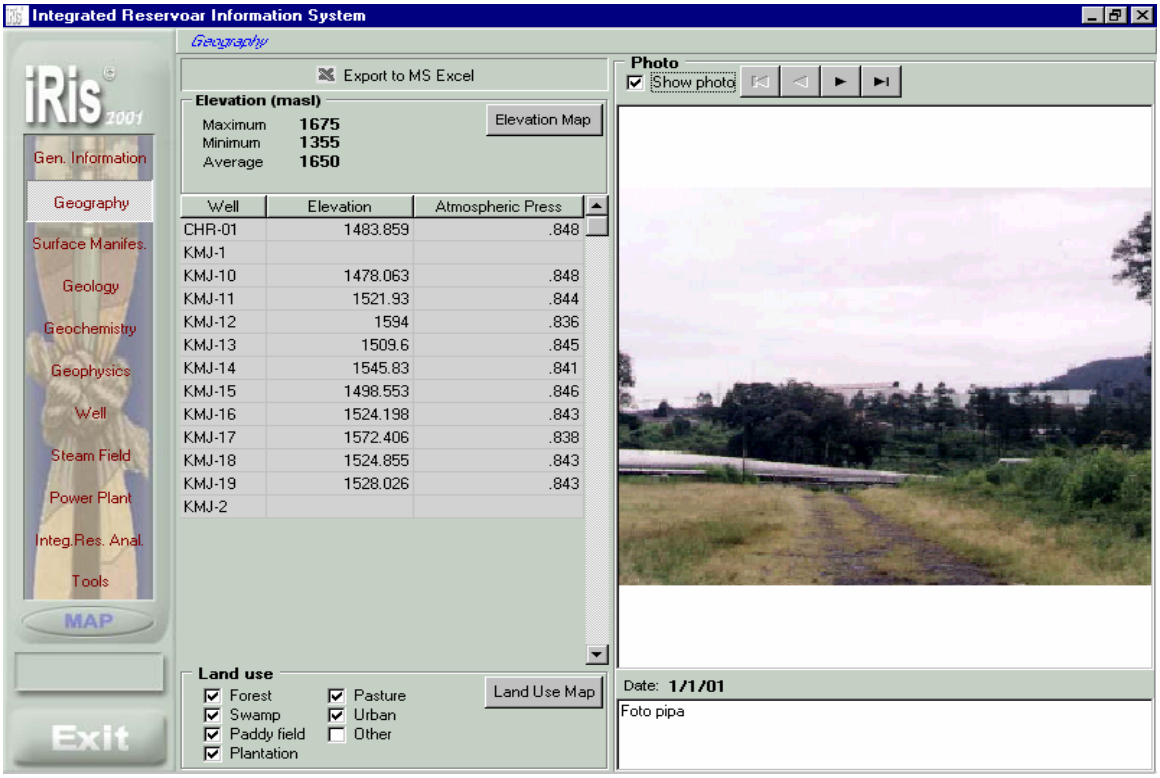

Figure 3: Module-2 Geography.

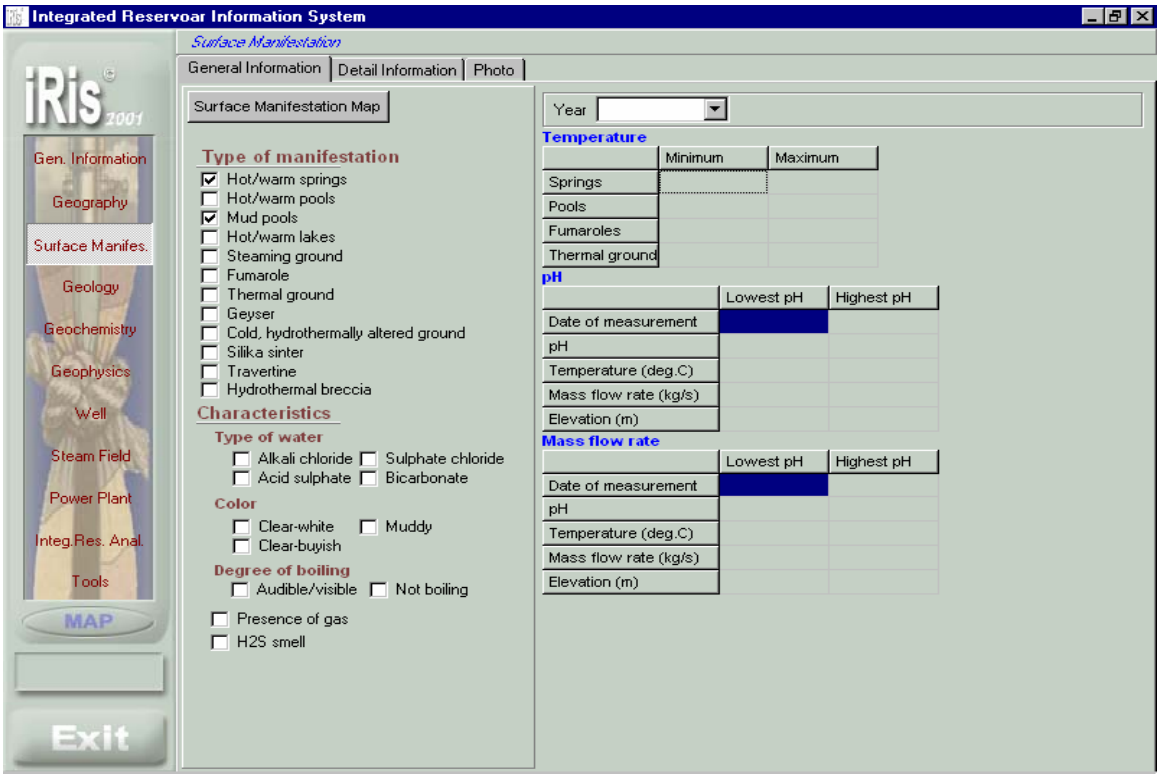

Figure 4: Module-3 Surface Manifestation.

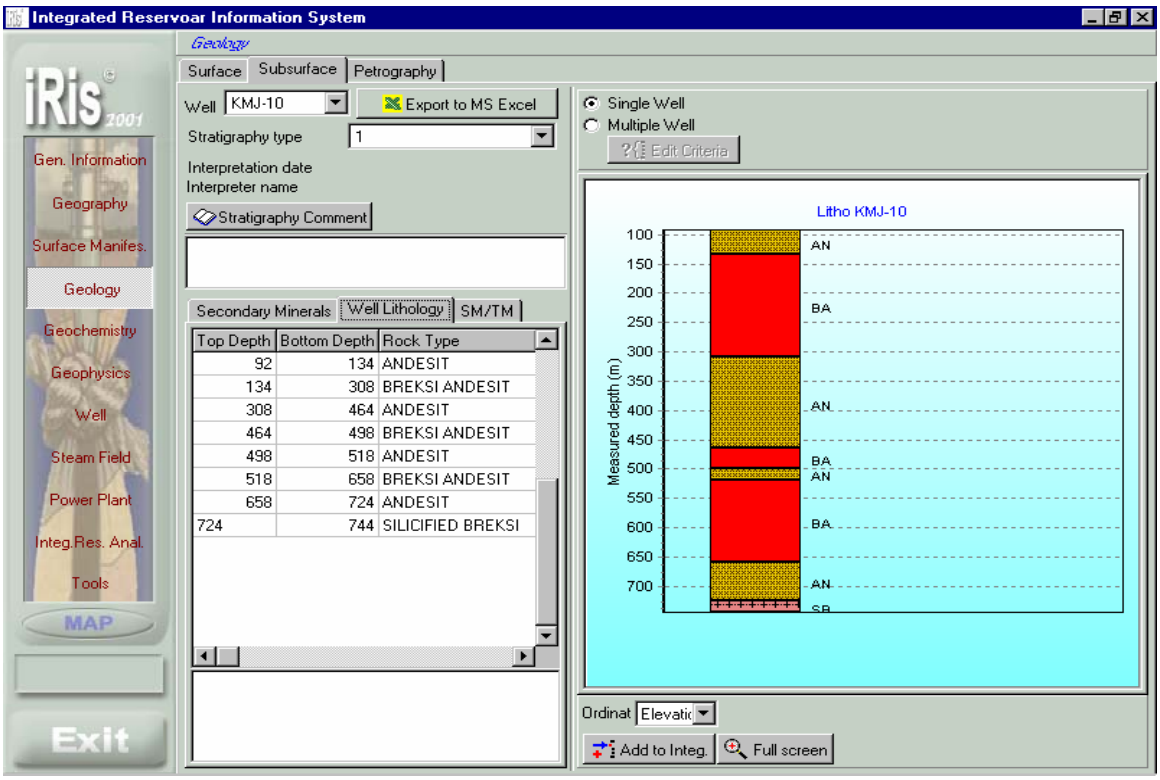

Figure 5: Module-4 Geology.

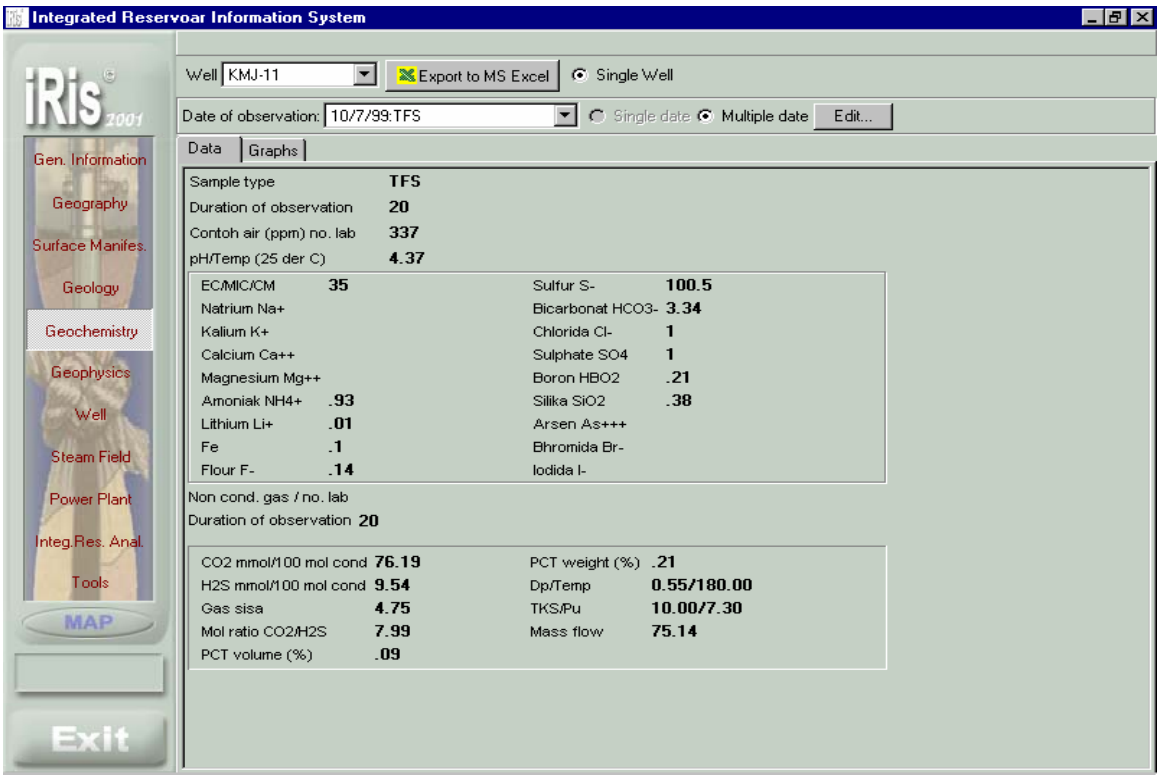

Figure 6: Module-5 Geochemistry.

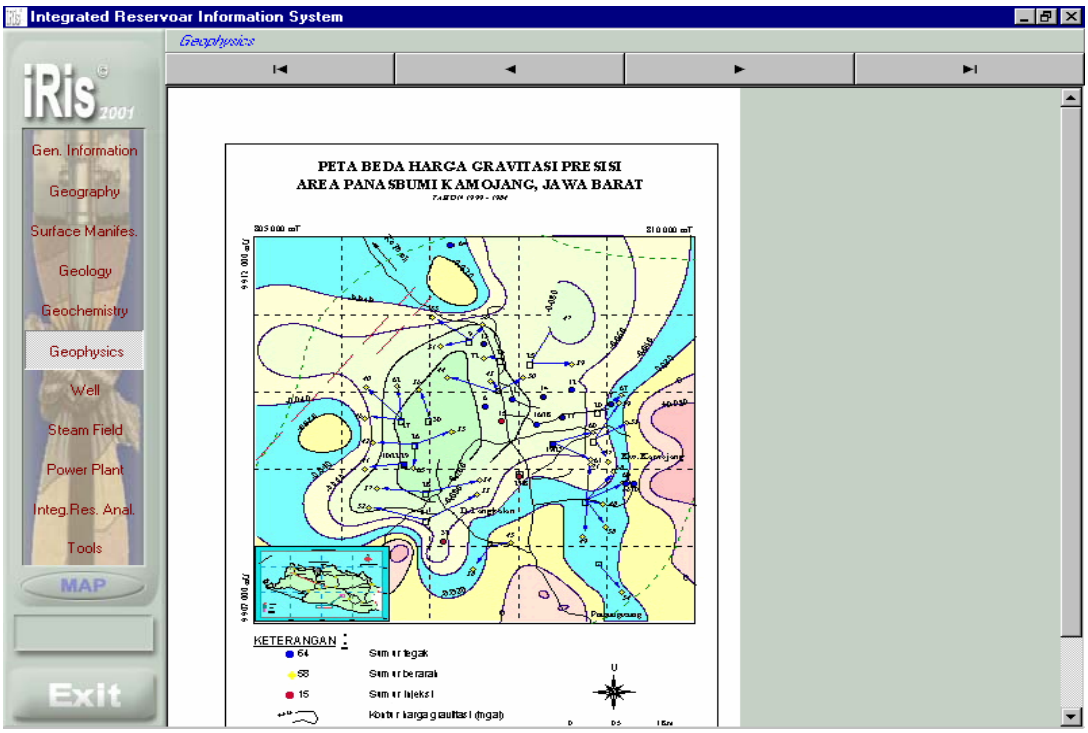

Figure 7: Module-6 Geophysics.

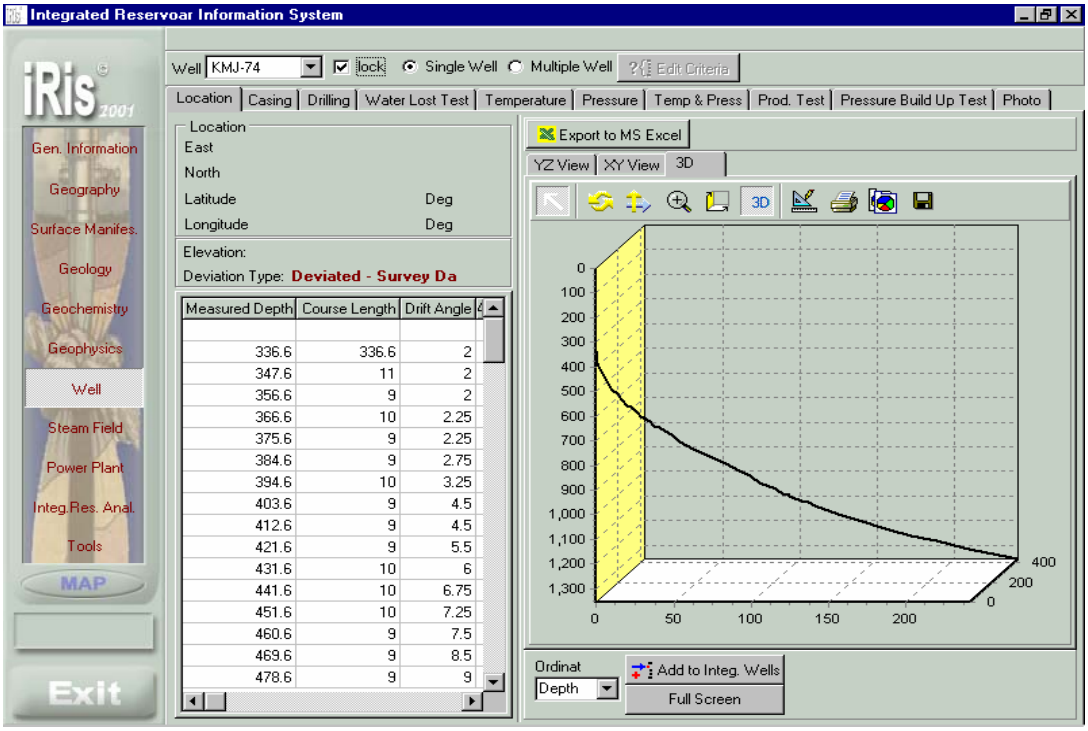

Figure 8: Module-7 Well.

2.8 Module-8 Steam Field

In this module user can get information easily concerning the pipe network in the field and rate of flow, temperature and enthalpy from each well into pipelines and total flow from each pipe line (Figure 9).

2.9 Module-9 Power Plant (generally)

Here the user can see Power Plant information of the field, either through graphical and textual presentations (Figure 10).

2.10 Module-10 Integrated Reservoir Analysis

In this module, the user can join various existing data and analyses of that existing data (Figure 11).

2.11 Module-11 Tools

The Tools module consists of 13 components divided into four categories:

1. **Drilling Software,** this software is used for the calculation of well trajectory pursuant to data result of drilling survey.

2. **Reservoir Engineering Software,** there are software components for the calculation of electrical potential and reserves, analysis of pressure transients and reservoir characteristics with geostatistical tools.
3. **Production Engineering Software c**an be used for calculation of: choke diameter, flow rate by using orifice plate, orifice design, and production test with lip pressure method, well bore simulation, well production with backpressure method and production forecast with interactive decline curve analysis.
4. **Fluid Properties and Geochemistry Software,** there are two types of software for the calculation of the nature of fluid thermodynamics and saturation index.

3. DISCUSSION

Since first well in Kamojang field was drilled in the year 1974, many kinds of data have been obtained. The data has been gathered in so many file forms according to the growth in usage of software and equipment during that time, and almost all the data is in the form of hard copy.

Therefore it was very difficult to do monitoring of reservoir condition and to conduct simulation to plan field development.

This problem was solved by the making of software to unite the assorted data into the same format. This software was called the Integrated Reservoir Information System.

The existence of this Integrated Reservoir Information System has been of great assistance in data collecting, monitoring of characteristics and comparison analysis of reservoir condition and well condition between early and current time.

Currently, IRIS was installed on a server and with the local area network connects to the personal computer for user access. To protect the data, the user must have a password to input or to search the data.

In the future, plans for IRIS will be to integrate with i-Tough-2 simulation software, so that the simulator can take data directly from IRIS, where it is easy to see. An interface is needed to be able to join the two applications.

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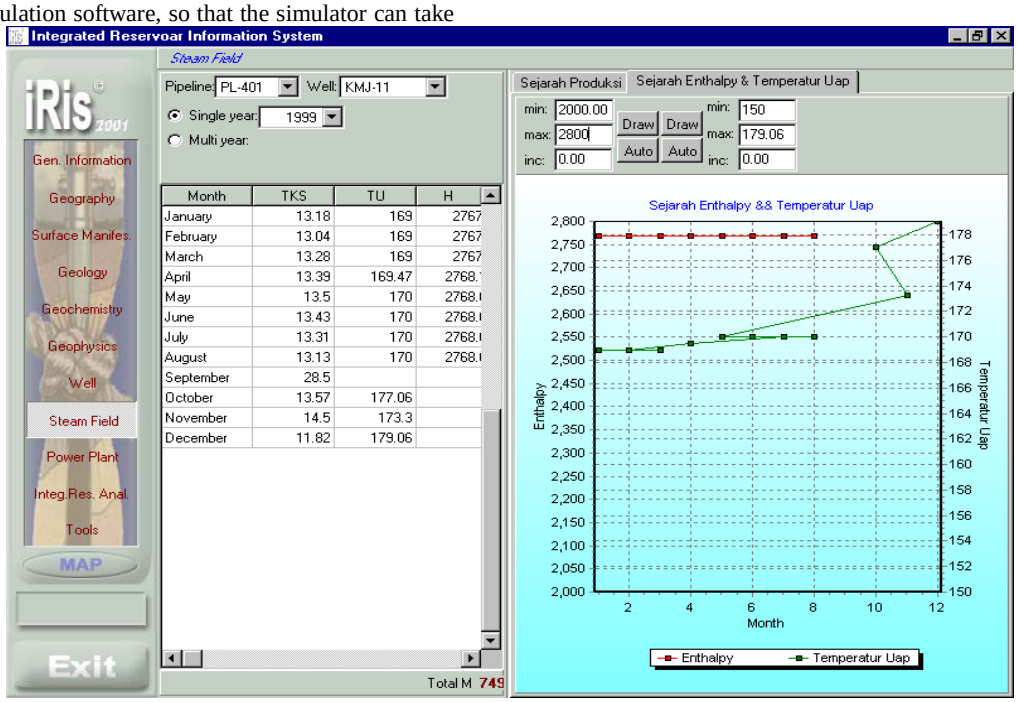
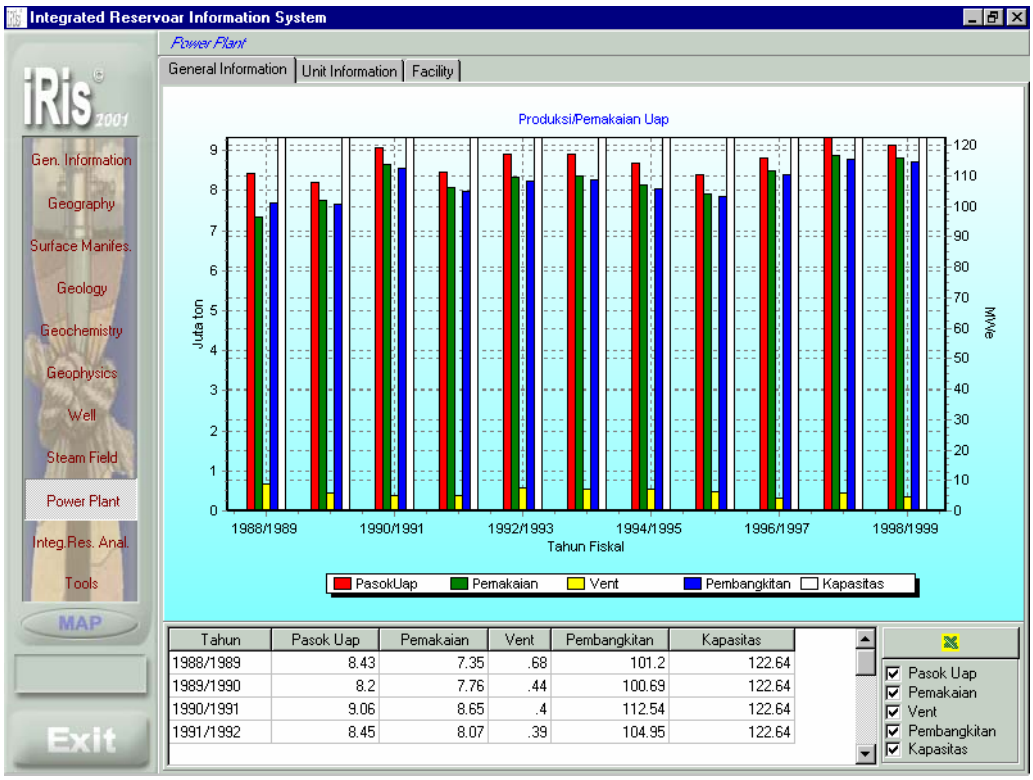


Figure 9: Module-8 Steam Field.



Tahun	Pasok Uap	Pemakaian	Vent	Pembangkitan	Kapasitas
1988/1989	8.43	7.35	.68	101.2	122.64
1989/1990	8.2	7.76	.44	100.69	122.64
1990/1991	9.06	8.65	.4	112.54	122.64
1991/1992	8.45	8.07	.39	104.95	122.64

Figure 10: Module-9 Power Plant.

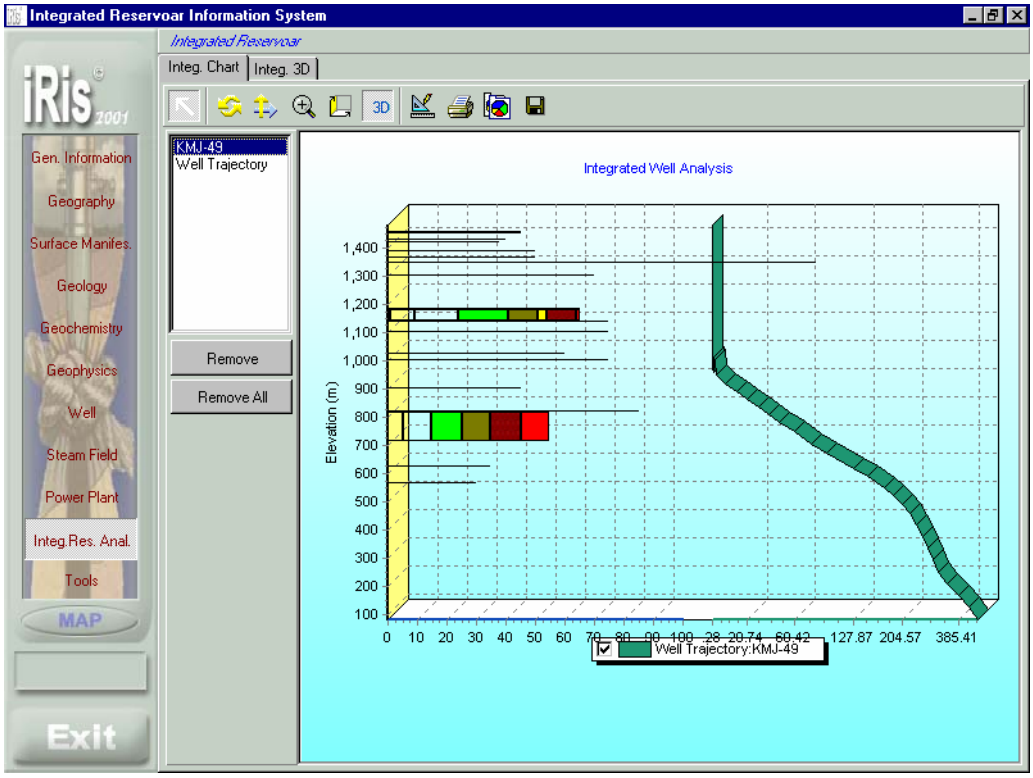


Figure 11: Module-10 Integrated Reservoir Analysis.