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MODELLING/SIMULATION OF OILWELL BOREHOLE LOGGING TOOLS

Fact Sheet

Project Information

Grant agreement ID: EN3C0014

Project closed

Start date
1 June 1987

End date
31 May 1989

Funded under
Research and development programme (EEC) in the field of Non-Nuclear Energy, 1985-1988

Total cost
No data

EU contribution
No data

Coordinated by
United Kingdom Atomic Energy Authority (UKAEA)
United Kingdom

Objective

THE AIM OF THIS PROJECT IS TO DEVELOP A NEW CODE PACKAGE, OPTIMIZED FOR THE CALIBRATION, INTERPRETATION AND DESIGN OF VARIOUS PULSED-NEUTRON LOGGING TOOLS.
Nuclear techniques are now routinely used for a variety of key measurements in oil well logging. Their accuracy is determined by the enviornment correction factors which must be applied to laboratory calibration data to take account of widely different operating conditions. Computer modelling can be used to generate

theoretical experiments to interpolate between sparse laboratory measurements and extrapolate with greater accuracy to the downhole environment.

Guidance for modelling nuclear logging tools has been provided using Monte Carlo perturbation theory to obtain quantitative estimates of the sensitivity of the response prediction to the representation of individual regions in the structure. Also, a finite element tracking algorithm has been tested which affords up to 50% saving in (CPU) time and reduces the user time by more than a half since it is unnecessary to set up 2 different geometry models. In the light of these results further gains in speed amounting to a factor of 2 or 3 were achieved with the McNUPA code.
Detailed studies have been made of the approximations involved in using multigroup data sets which afford a saving in computer time of about a factor 2 and a kernel algorithm has been devised for predicting the pulse height distributions obtained with gamma-spectroscopy tools with major savings in computing time.
A new code ELECTRA has been written to track electron events. The prediction of the pulse height spectra in the sodium iodide crystal detectors were in excellent agreement with experiment. Significant changes were observed in the shape of the pulse height distributions calculated for gamma spectroscopy tools when electron tracking was included in the McBEND modelling.
A new colour graphics package, McPLOT has been written which provides special diagnostics required for McBEND users and the 2-tier suite has been implemented on a VAX minicomputer with major savings in the overall cost of computing.
COMPUTER MODELLING AS AN AID TO THE DESIGN, CALIBRATION AND INTERPRETATION OF NUCLEAR LOGGING TOOLS DOES NOT PLAY A SIGNIFICANT ROLE DUE TO THE EXCESSIVE MAINFRAME COMPUTING TIME REQUIRED. ALL THE MORE SO WITH PULSED-NEUTRON TOOLS, WHICH INTRODUCE ANOTHER DIMENSION AND WITH GAMMA SPECTRUM ANALYSIS.
MEASUREMENT OF FORMATION CROSS-SECTIONS BY THE PULSED-NEUTRON TECHNIQUE IS OF A LIMITED ACCURACY DUE TO SIGNAL DISTORTIONS. A FULL COMPOSITIONAL ANALYSIS OF THE ROCK MATRIX AND ASSOCIATED PORE FLUID SHOULD BE PROVIDED BY CARBON-OXYGEN LOG AND GAMMA SPECTROSCOPY TOOLS, BUT THE SENSITIVITY AND RESOLUTION ARE LIMITED. SIGNIFICANT IMPROVEMENTS CAN ONLY BE ACHIEVED BY THE USE OF NEW COMPUTER MODELLING TECHNIQUES ALLOWING QUANTITATIVE PREDICTIONS OF THEIR PERFORMANCE WITH STRONGLY REDUCED COMPUTING TIMES. SUCH TECHNIQUES ALREADY PROVED SUCCESSFUL WITH STEADY-STATE NUCLEAR LOGGING TOOLS, WILL BE BASED ON THE FOLLOWING POINTS:

.- A SIMPLIFIED GEOMETRIC MODELLING OF THE TOOL AND BOREHOLE,
.- A NEW PARTICLE TRACKING PRINCIPLE USING SIMPLIFIED DIFFUSION THEORY MODELS TO IDENTIFY THE IMPORTANT HISTORIES THUS BIASSING THE STATISTICAL SAMPLING PROCESS TO INCREASE THE

EFFICIENCY OF THE COMPUTATION,
.- AVERAGING THE BASIC CROSS-SECTION DATA IN RELATIVELY WIDE ENERGY GROUPS. USING A SIMPLE KERNEL METHOD FOR UN-COLLIDED FLUX AND SUPER-IMPOSING THE SCATTERED FLUX BACKGROUND SCORED BY MONTE CARLO METHOD WOULD PERMIT THE REQUIRED RESOLUTION TO BE ATTAINED.
.- EXAMINING THE EVENTS WITHIN THE DETECTOR BY TRACKING THE SECONDARY BETA PARTICLES THUS ALLOWING THE DESIGN OF MORE SENSITIVE AND SMALLER TOOLS.
.- INCORPORATING A FULLY INTERACTIVE COLOUR GRAPHICS PACKAGE ALSO FOR ERROR DIAGNOSTICS IN THE PROBLEM DATA INPUT.
.-RUN ON THE NEW GENERATION OF SUPER MICRO-COMPUTERS THUS OBTAINING CONSIDERABLE SAVING IN COMPUTING COSTS.
CO-OPERATION WITH TECHNICAL UNIVERSITY OF DENMARK IS FORESEEN (SEE CONTRACT EN3C000900-DK (MB)).

Fields of science (EuroSciVoc)

engineering and technology > electrical engineering, electronic engineering, information engineering > electronic engineering > computer hardware > **computer processors**

engineering and technology > materials engineering > **colors**

natural sciences > chemical sciences > inorganic chemistry > **alkali metals**

natural sciences > mathematics > pure mathematics > **geometry**

natural sciences > physical sciences > optics > **spectroscopy**

Programme(s)

FP1-ENNONUC 3C - Research and development programme (EEC) in the field of Non-Nuclear Energy, 1985-1988

Topic(s)

Data not available

Call for proposal

Data not available

Funding Scheme

CSC - Cost-sharing contracts

Coordinator

United Kingdom Atomic Energy Authority (UKAEA)

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