

SCIENTIFIC NOTEBOOK

No. 246

Valid Dates: 4/1/98-6/30/98

by

AMIT ARMSTRONG

**Center for Nuclear Waste Regulatory Analyses
Southwest Research Institute
San Antonio, TX**



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QA

Initial Entries

Scientific Notebook: 246

Issued to: Amit Armstrong, Research Engineer

Issue Date: March 1, 1998

By agreement with the CNWRA QA this Notebook is to be printed at approximate quarterly intervals. This computerized Scientific Notebook is intended to address the criteria of CNWRA QAP-001.

Table 0-1: Computing Equipment

Machine Name	Type	Operating System	Location
sisyphus.cnwra.swri.edu	Sun SPARC 20	Sun Solaris 2.5.1	Rm 210/Bldg.189
performer.cnwra.swri.edu	SGI Onyx	IRIX 5.3	Network
hydra.cnwra.swri.edu	Pentium II	Win/NT 4.0	Rm 210/ Bldg. 189
sneezy.cnwra.swri.edu	Sun SPARC 10	Sun Solaris 2.5.1	Network
dopey.cnwra.swri.edu	Sun SPARC 10	SUNOS 4.1.2	Network

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1.1 Drift Scale Heater Test Modeling	

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Thermal Effects on Flow KTI

Account Number: 20-1402-661
Collaborators: Ron Green

1.1 Drift Scale Heater Test Modeling

Develop a model to simulate drift scale heater test (DST) in Exploratory Research Facility (ESF) at Yucca Mountain (YM).

1.2 Methodology

1.2.1 Model Selection

The DST will involve a long term heating followed by a long term cooling of the drift. The model domain can be modeled both by ECM or DKM. Multiflow is selected for modeling DST so that both ECM and DKM can be used. Preliminary simulations will be conducted by ECM using the Multiflow simulator. Ron Green will use the DKM to test the DKM capabilities, currently under development, of the Multiflow. Current models will use the finite difference grid, however, it can be changed to the integrated finite difference grid when it becomes available in the Multiflow.

1.3 Preliminary Simulations

1.3.1 Model Description

Due to the symmetrical nature of DST and its heater placements, it is most efficient, at least computationally, to model only the one-fourth volume. The one-fourth volume domain was discretized into 3-D Cartesian coordinate system with varying block sizes. There are 15 nodes in the x-direction, which runs parallel to the drift longitudinal axis, with lengths of 8, 8, 8, 1, 1, 1, 1, 1, 2, 2, 2, 3, 5, 5, and 25 m. There are 20 nodes in y-direction, which runs parallel to drifts transverse axis, with lengths of 0.66, 0.67, 1, 1, 1, 3, 1, 1, 3, 1, 1, 1, 2, 2, 5, 5, 10, 10, and 50 m. There are 23 nodes in the z-direction, representing elevation, with lengths of 50, 20, 20, 10, 5, 2, 2, 2, 1, 1, 1, 1, 0.5, 1, 1.5, 1, 1, 1, 2, 10, 20, 20, and 50 m. The applied boundary conditions include no flux across the boundary. The matrix and fracture continuum is modeled by Equivalent Continuum Method (ECM). The ECM will provide the combined response of fracture and matrix with the assumption that the properties ascribing the system represent both.

Both canister floor heaters and wing heaters were represented as the volumetric heat source. A total energy output of 16.875 kW was provided by canister heaters. The wing heaters were represented by both inner and outer heaters. The energy output was 14.31 kW and 21.48 kW from of inner and outer wing heaters respectively. The data for energy output is based on the details provided by TRW



Environmental Safety Systems, Inc. (1997). The system was heated for a total of 4 years and then was allowed to cool down for one year.

1.3.2 Simulation Results

Two simulations were performed with slightly different heating. However, the results discussed will be limited to just one simulation with heating source as described in previous section. The temperature distribution after 4 years and 5 years is presented in Fig. 1 and 2. The maximum temperature attained after 4 years was 406.5°C at the center of canister heater, however, the maximum temperature after one year of cooling down (total time elapsed= 5 years) was 142.3°C at the drift wall. The extent of boiling isotherm (96°C) after four years of heating is shown in Fig. 3. The liquid saturation distribution does not indicate the a smooth and symmetric dry out zone. As shown in Fig. 4 and 5, there are some sharp edges which could be indicative of either a coarse discretization or numerical error in convergence.

1.3.3 Future Work

As the data from the DST will become available, this conceptual model will be refined and calibrated to match measured data. Measured data will also be required to modify the MULTIFLO simulator as it showed some discrepancy in handling long-term heating, pressure at no flux boundary nodes, and liquid saturation distribution.

Aa

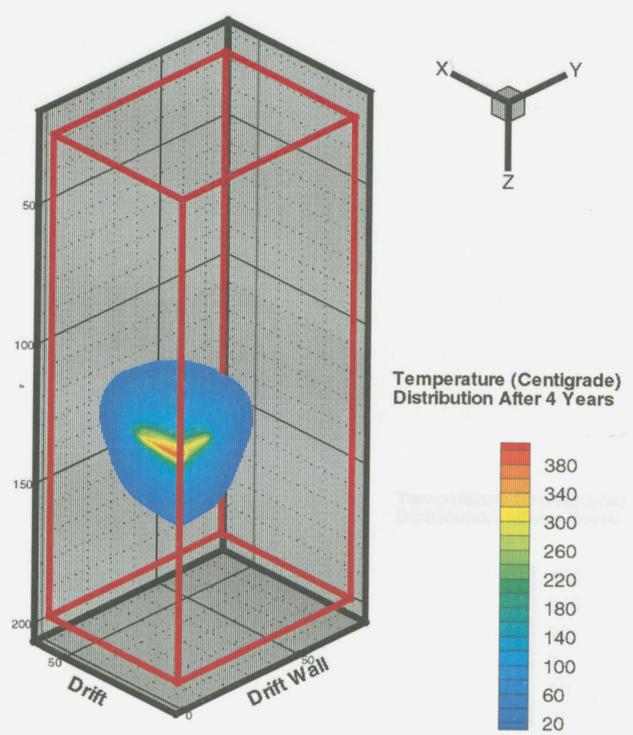


Figure 1 Temperature (°C) Distribution after 4 years

AR

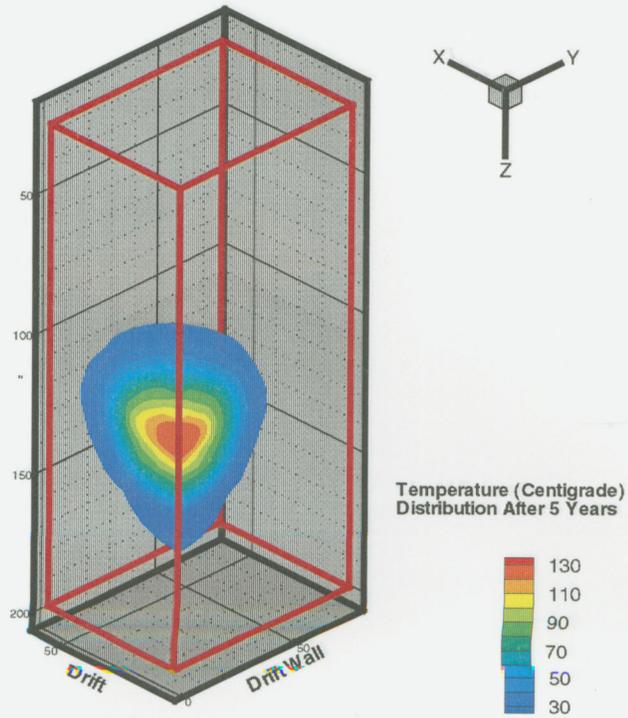


Figure 2 Temperature ($^{\circ}\text{C}$) Distribution after 5 years

pe

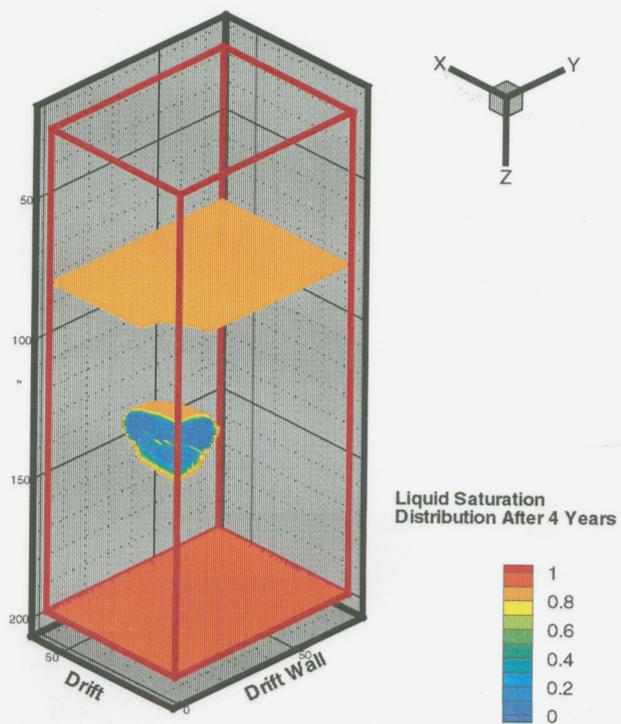


Figure 3 Liquid Saturation Distribution after 4 years

Am

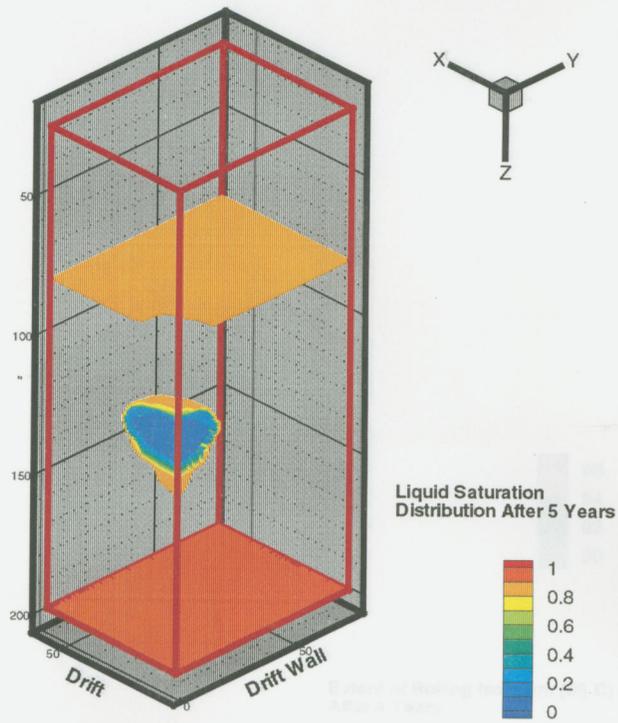


Figure 4 Liquid Saturation Distribution after 5 years

Ra

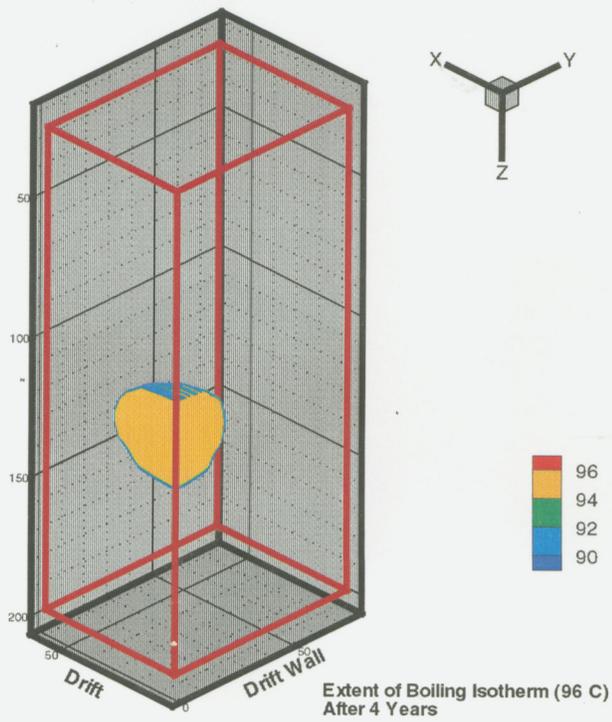


Figure 5 Extent of Boiling Isotherm (96 °C) after 4 years

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Thermal Effects on Flow KTI

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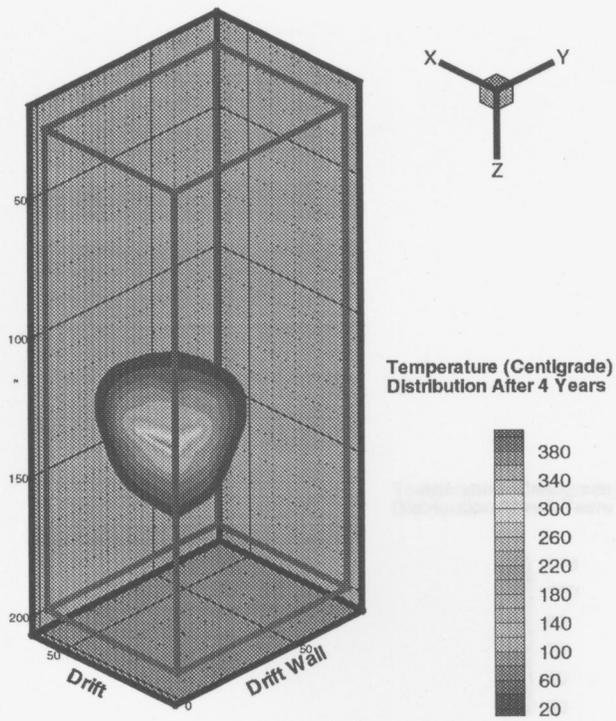


Figure 1 Temperature ($^{\circ}\text{C}$) Distribution after 4 years

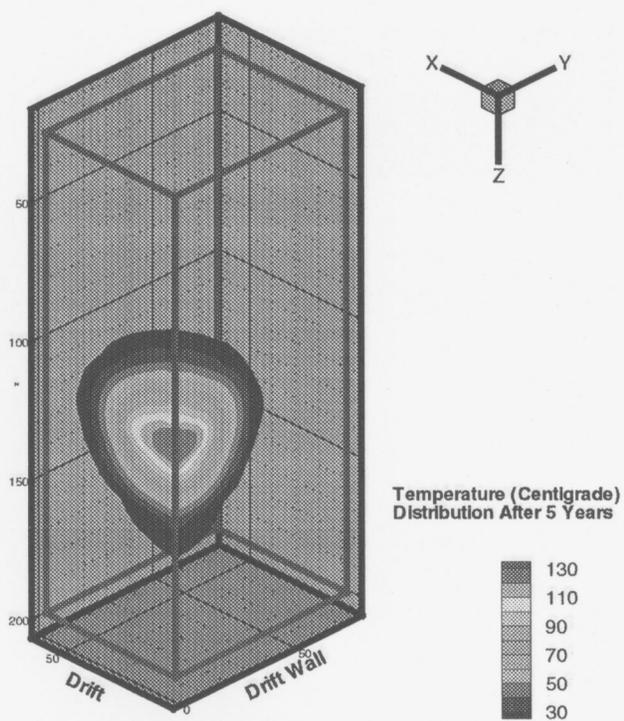


Figure 2 Temperature (°C) Distribution after 5 years

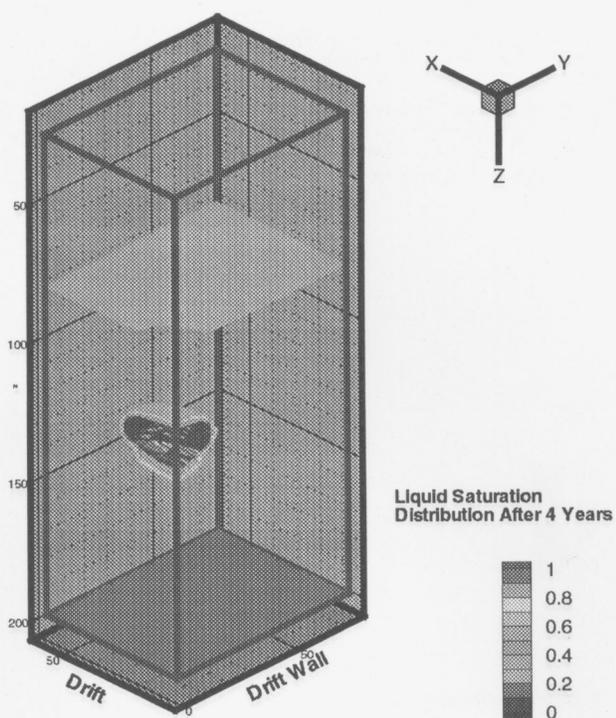


Figure 3 Liquid Saturation Distribution after 4 years

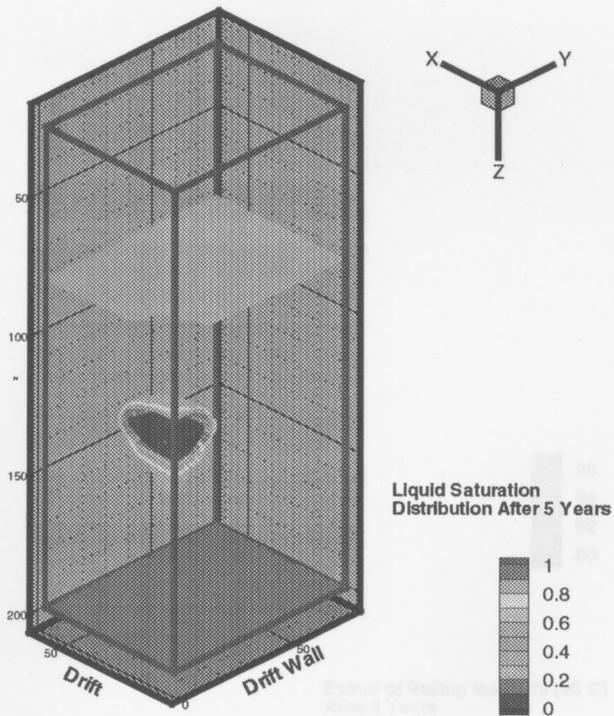


Figure 4 Liquid Saturation Distribution after 5 years

December 22, 1999

Final Entry

All entries in notebook no. 246 are made by Amit Armstrong from 4/1/98 to 12/22/99.

No original text has been removed from this notebook.

Amit Armstrong
12/22/99

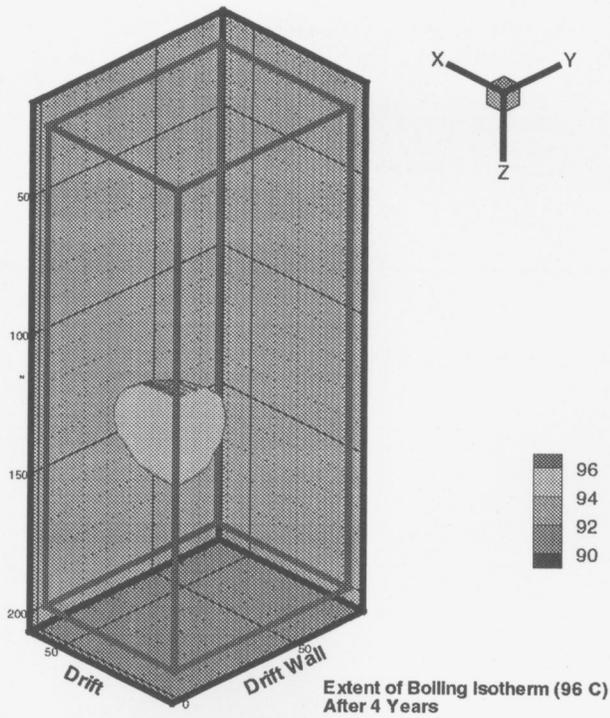


Figure 5 Extent of Boiling Isotherm (96 °C) after 4 years

December 22, 1999

Final Entry

All entries in notebook no. 246 are made by Amit Armstrong from 4/1/98 to 12/22/99.

No original text has been removed from this notebook.

Amit Armstrong
12/22/99

Date: 10/29/99
Sender: Amit Armstrong
To: Bruce Mabrito, English Percy
Priority: Normal
Receipt requested
Subject: Scientific Notebook

From the Desk of Amit Armstrong

Bruce:

There are no new entries in the scientific notebook nos. 239 and 246 as I did not charge any time to these projects.

I will send you a printed version of notebook no. 214 on Monday.

Thanks,

Amit

*Amit Armstrong
Senior Research Engineer
Geohydrology and Geochemistry Element
CNWRA/ Southwest Research Institute
6220 Culebra Road
San Antonio, TX 78238
Phone: (210) 522-5182
Fax: (210) 522-5155
e-mail: aarmstrong@swri.org*

Date: 5/13/99
Sender: Amit Armstrong
To: Bruce Mabrito
Priority: Normal
Receipt requested
Subject: Re:Electronic Scientific Notebooks - Second Call
Bruce:

I have made no entries in electronic scientific notebook nos.. 214, 239, and 246.

Amit Armstrong

Reply Separator

Subject: Electronic Scientific Notebooks - Second Call
Author: Bruce Mabrito
Date: 5/12/1999 11:13 PM

On April 1, 1999, we placed the first call for "print outs" of electronic scientific notebooks or notification of no entries, or closing them out.

We received prompt response from the following individuals:

**Rui Chen
Britt Hill
Roberto Pabalan
Scott Painter
Stu Stothoff**

Thanks to you.

We are still looking for hard copy pages of electronic scientific notebook entries from January 1, 1999 through March 31, 1999 for the following individuals:

**Amit Armstrong
Charles Connor
Amit Ghosh (although, he did promptly close out his electronic scientific notebook No. 167)
Sitakanta Mohanty**

Thanks for responding to this message. There is no doubt that the QA Audit in early June will be checking this periodically mandated action.

Bruce

Date: 1/22/99
Sender: Amit Armstrong
To: Bruce Mabrito
Priority: Normal
Receipt requested
Subject: Re: Second Call for Electronic Scientific Notebooks

*Electronic
S/Notebooks
214, 239, 246*

Bruce:

I have made no entries in electronic scientific notebook nos.. 214, 239, and 246.

Amit Armstrong

Reply Separator
Subject: Second Call for Electronic Scientific Notebooks
Author: Bruce Mabrito
Date: 1/22/1999 12:14 PM

CNWRA Electronic Scientific Notebook Holders:

Amit Ghosh and Bobby Pabalan have turned in printed copies of their (total of four) electronic scientific notebooks.

The remainder of CNWRA electronic scientific notebook holders (listed as addresses in this message) still owe QA a printed copy of their inputs from Oct. 1, 1998 through Dec. 31, 1998, or, an e-mail note stating they have made no entries.

A single, unbound copy can be provided to Maria Padilla or me. We keep the unbound copies in the QA Records Room and they will be bound when it is mutually decided they are complete or that a notebook is of sufficient volume to warrant binding. Call me if you have questions. We would appreciate your input soon.
Bruce x 5149

cc: Stu Stothoff (via E. Percy)

Date: 11/20/98
Sender: Amit Armstrong
To: Bruce Mabrito
Priority: Normal
Receipt requested
Subject: Re: Status on Turn In/Response to Electronic Scientific Noteb

Bruce:

I have no new entries in Notebooks 214,239, and 246 this quarter.

Amit

Reply Separator

Subject: Status on Turn In/Response to Electronic Scientific Notebook
Author: Bruce Mabrito
Date: 11/15/98 10:41 PM

The "call" for electronic scientific notebooks from October 1, 1998 has yielded these results to date.

Responses from: Chuck Connor (s/n # 115 turned in); Randy Fedors ("no entries" email on s/n # 245); Amit Ghosh (no entries email on s/n # 250); Britt Hill (turned in s/n # 88 pages); Sitakanta Mohanty (no entries email for s/n # 170); Roberto Pabalan (no entries email on s/n # 185 and turn in of pages on s/n # 278);

Stu Stothoff (messages passed through E Percy) (no entries email on s/n # 163).

Those electronic scientific "notebooks" yet to be "heard from" are:

Amit Armstrong (s/n # 214, 239, 246)

Rui Chen (s/n # 254, 274)

Chuck Connor (s/n # 267)

Amit Ghosh (s/n # 167)

Scott Painter (s/n # 282)

As always, if we have numbers incorrectly listed, please let me know. If you have no entries to report, simply so state in an email to me and we will print that note and put it in the folder for this quarter. If you have pages to turn in, please follow QAP-001 and submit only the pages and do not bind them at this time).
Many thanks. Bruce