

OFFICIAL TRANSCRIPT OF PROCEEDINGS

Agency: Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards

Title: Subcommittee Meeting on Thermal Hydraulic Phenomena

Docket No.

LOCATION: Monroeville, Pennsylvania

DATE: Wednesday, March 16, 1994

PAGES: 513 - 534

Closed session pages: 274A-512

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UNITED STATES NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

DATE: March 16, 1994

The contents of this transcript of the proceedings of the United States Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards, (date) March 16, 1994, as Reported herein, are a record of the discussions recorded at the meeting held on the above date.

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1
2 UNITED STATES OF AMERICA
3 NUCLEAR REGULATORY COMMISSION

4 ***

5 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
6 SUBCOMMITTEE MEETING ON THERMAL HYDRAULIC PHENOMENA
7

8
9 Westinghouse Energy Center
10 East Auditorium
11 National Pike
12 Monroeville, Pennsylvania
13

14 Wednesday, March 16, 1994
15

16 The above-entitled proceedings commenced at 8:00
17 a.m., pursuant to notice, Ivan Catton, Subcommittee
18 Chairman, presiding.

19 PRESENT FOR THE ACRS SUBCOMMITTEE:

20 Peter R. Davis, Member

21 Robert L. Seale, Member

22 V.J. Dhir, Consultant

23 Wolfgang, Wulff, Consultant

24 Novak Zuber, Consultant

25 Paul A. Boehnert, Designated Federal Official

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OPEN SESSION

1
2 MR. KUDRICK: My name is Jack Kudrick. I'm a
3 Section Chief within the Containment and Severe Accident
4 Branch within NRR. Basically, we have the responsibility
5 for reviewing all the containment-related issues relative to
6 advanced plants, as well as operating plants.

7 As you are well aware, we are near the closure for
8 the evolutionary plants and up until now most of our
9 resources have been devoted to the evolutionary plants. But
10 as of now, we've basically taken those resources that have
11 been used for the evolutionaries and put them on
12 specifically AP-600. So we are gearing up for a review of
13 the AP-600.

14 Unfortunately, we are just beginning. So what we
15 hope to do is just give you some idea of how we intend to
16 approach closure of the issues of the AP-600, as well as
17 what some of the significant issues are. Mr. Chris Hoxie,
18 who is the lead reviewer for our branch, will be basically
19 going over, first the schedule or what we perceive as the
20 schedule for our review and then follow that up with some
21 comments on the way we intend to approach it.

22 Basically, with that, I'll turn it over to Chris.

23 MR. HOXIE: Thank you, Jack. This is, I want to
24 start by saying, not an official NRC schedule. It's really
25 my or SESB's, at best, our best estimate of where things are

1 going. So let me start with the first black diamond.
2 That's today's ACRS meeting. If you go back in time a
3 little bit, last fall, you've heard about the tests that
4 Westinghouse has been running. They ran the phase two and
5 three large-scale tests, the PCCS test, they ran the wind
6 tunnel tests, they ran water distribution tests. I observed
7 personally two of the PCCS tests, one of the wind tunnel
8 tests and one of the water distribution tests.

9 Moving on down, the next thing is, especially
10 important for us, of those tests for containment
11 performance, are the PCCS tests. What I have there are
12 WGOthic PCCS test analyses and CONTAIN PCCS test analyses.
13 Let me start with the WGOthic one. As you can see, it spans
14 quite a period of time and ends up with a blind test
15 prediction, which I think was mentioned a few times today.

16 Our national lab, Sandia, has NRC's CONTAIN code.
17 They usually lag behind Westinghouse and so you see a slight
18 shift. Then moving on to code verification and validation,
19 in the WGOthic space, one of the really key milestones for
20 us is the WGOthic WCAP Revision 1. We have a Rev. 0 that I
21 know the ACRS members have, but an important one is the
22 Revision 1, which pulls together a lot of the things that
23 they're talking about and that Westinghouse has said that
24 they'll have more scaling rationale in it. So that's not
25 until around May of 1995.

1 Similarly, then, we'll be doing similar things
2 with our CONTAIN code. However, our emphasis is really
3 going to be on the WGOthic code, because that's the thing
4 that the licensing action is based on. The CONTAIN is more
5 confirmatory.

6 MR. CATTON: The CONTAIN is your confirmatory
7 evaluation.

8 MR. HOXIE: That's correct. Under NRC reviews,
9 then, we have reviews going or will have shortly on the
10 WGOthic code itself, PCCS scaling. Both of those two are
11 going to be done at Sandia National Laboratory. And severe
12 accident phenomenology, which is also at Sandia.

13 MR. CATTON: Does this severe accident
14 phenomenology include the flooding of the lower cavity to
15 save the core?

16 MR. HOXIE: Yes, it does.

17 MR. CATTON: Some of us have a very strong
18 interest in that, particularly one of my consultants. We're
19 getting outside of what we're here for. I just want to sort
20 of --

21 MR. KUDRICK: In fact, we see some unique review
22 areas specifically for the AP-600 in that regard.

23 MR. WULFF: What are the scaling activities taking
24 over a year-and-a-half that terminates when everything else
25 is terminated? It seems to me that that should have been

1 completed much earlier and, two, it shouldn't take as long.

2 MR. GRESHAM: The GOTHIC WCAP Rev. 1 will have the
3 completion of all the scaling information that we're doing.
4 We are going to be talking to the NRC about a mechanism to
5 get them information along those lines and other information
6 relative to the AP-600 PCCS on a shorter schedule. That
7 basically supports this triangle for their DSER. So we're
8 going to be giving them information ahead of that.

9 MR. HOXIE: That's a really key point, because for
10 this schedule to have a prayer of working, we can't wait
11 until May 1995.

12 MR. CATTON: Yes, because you may conclude that
13 there's something lacking.

14 MR. HOXIE: That's exactly right.

15 MR. CATTON: That has an instantaneous impact on
16 the schedule.

17 MR. HOXIE: So really from our point of view,
18 we're starting -- we have another meeting with Westinghouse
19 tomorrow where we're going to be talking about a closer
20 cooperation. We've got to get the information before that
21 diamond in May 1995.

22 MR. WULFF: But this is the middle of 1994, which
23 is now. No, May.

24 MR. CATTON: September. SRP review due to PM is
25 September. So are you going to do this at the same time the

1 review for CMT comes in?

2 MR. KUDRICK: Yes. As a matter of fact, we don't
3 want to give an impression that we're just starting our
4 review of scaling. We have had efforts underway on scaling
5 and basically they have, in part, led us to some of the RAIs
6 that we've already issued. We will continue to pursue
7 scaling because we feel it's important with Westinghouse.
8 As Jim indicated, there is a need to have this continuous
9 dialogue on scaling, because normally scaling is done up-
10 front and then everything else follows. But in this
11 particular case, we're basically in parallel or in back of.

12 MR. ZUBER: Who is doing the scaling for the PCCS?
13 You said PCCS scaling. Who is doing that?

14 MR. HOXIE: That's being done at Sandia and there
15 will be several people. One of them, for example, is Marty
16 Pilch, who you probably know.

17 MR. ZUBER: It's being done for new or for the
18 research?

19 MR. KUDRICK: Both. Basically, we are integrating
20 both Research efforts, as well as NRR efforts to get our
21 hands around the scaling issues.

22 MR. ZUBER: But who is it? There should be one
23 boss, one driver. Who is the driver? Is it NRR or RES?

24 MR. KUDRICK: I think NRR is the driver.

25 MR. ZUBER: I'm just trying to see if the

1 responsibility divided between two offices or one office
2 will have the responsibility.

3 MR. KUDRICK: We have the responsibility for AP-
4 600.

5 MR. CATTON: We just sneer if Research doesn't do
6 it. He gets in trouble. With this sort of ongoing process,
7 I don't want us to throw a multi-wrench into this at some
8 last minute. If you could keep Paul informed of when you
9 have meetings, I'd like occasionally to send one of the
10 consultants to it.

11 MR. KUDRICK: We'd be more than happy to do that.

12 MR. CATTON: That way when we have a meeting like
13 this, we're all right up to speed.

14 MR. KUDRICK: If we learned anything relative to
15 looking at this rescheduling, and this is a rescheduling
16 very recently, and that is that we're -- if we have any
17 hopes of achieving anywhere near the dates that are noted
18 there, we need cooperation and we would be more than happy
19 to keep you aboard.

20 MR. CATTON: So if you have a schedule of your
21 planned interactions, if you could get that to Paul, then we
22 could decide which to participate in.

23 MR. KUDRICK: We're developing that.

24 MR. HOXIE: Yes. You've asked plenty early,
25 because we don't have it at this point in time.

1 MR. CATTON: That's why I'm asking.

2 MR. ZUBER: Do you still plan to have a meeting in
3 September on this?

4 MR. CATTON: We would probably have to have some
5 kind of meeting in conjunction with the SRP review due to
6 PM. What does PM mean?

7 MR. HOXIE: Project manager. Let me say something
8 about --

9 MR. CATTON: Somewhere at that point.

10 MR. KUDRICK: Let him talk about that.

11 MR. HOXIE: Something that we need to understand -
12 - here, Novak, is the one that they were referring to. As
13 you can see, at this diamond, we're not going to have that.
14 The bottom line is this. At that diamond, we're going to do
15 what we can of a standard SRP review and it's going to cover
16 things like containment leak rate testing, containment
17 isolation valves. It's not going to do analysis.

18 MR. CATTON: Those things aren't my business.

19 MR. HOXIE: That's right.

20 MR. CATTON: So it leaves open issues.

21 MR. HOXIE: It's going to be an open issue. We
22 can't do better than that by August.

23 MR. CATTON: But it's not as critical for us.

24 MR. KUDRICK: From the point of view of the
25 interest of the Subcommittee, what we will not have in there

1 will be the analysis, both DBA, as well as severe accident,
2 as well as the testing.

3 MR. ZUBER: I think throughout the day-to-day, we
4 have done this, but we are not presenting we have done this.
5 I think it will be prudent if we have what is the answer on
6 the two-day meeting. I realize the thing was really -- I
7 couldn't put my arm around it to understand exactly. I have
8 a feeling they're really walking into a forest.

9 It would be advisable to have -- if they have done
10 this work and they didn't present it here, it will be
11 desirable to maybe have a meeting in September on the things
12 they have, so that at least we can pass an opinion and give
13 a judgment of something; not to really postpone it until,
14 let's say, December or January. By that time, there is no
15 time left.

16 MR. KUDRICK: Ivan made a point. We're going to
17 be meeting several times with Westinghouse between now and
18 then. It will be dependent upon what type of information is
19 available, but we will keep you informed.

20 MR. CATTON: That's good.

21 MR. HOXIE: The last point on there probably --
22 you can tell from all this that, in my opinion, the FSER
23 data is probably the most uncertain. It's furthest out in
24 time and it really depends, again, on the types of
25 cooperation that we have and successfully working with

1 Westinghouse to get us the information we need to make the
2 judgment.

3 MR. CATTON: I guess the firmness of that last
4 black diamond is Westinghouse's -- it's in their court.

5 MR. KUDRICK: That's our feeling.

6 MR. HOXIE: I wanted to get into just a brief
7 overview of how we were going to go about the review. We
8 tend to think of the review in two pieces, a DBA piece and a
9 severe accident piece. Our DBA review will be structured
10 around our standard review plan, but there will be some
11 deltas that are caused by the passive nature of this plant,
12 design considerations.

13 Some of the ones that I've listed are the ones
14 that --

15 MR. CATTON: Do you place this cooling of the
16 lower head under the category of passive systems?

17 MR. HOXIE: It's passive, but it's severe
18 accident. I'll do severe accident and then --

19 MR. CATTON: I understand.

20 MR. HOXIE: Some of the things in DBA space, these
21 plants have no safety-related AC power. This plant has no
22 containment sprays. So if we license this, that will be the
23 first time that we've licensed a PWR with no containment
24 sprays. They have standard DBA recombiners, but they do not
25 have safety-related power. That's a new thing for us.

1 Then the other thing is they interface -- they
2 have a lot of the standard systems that are in today's PWRs,
3 but they are now non-safety. But they have an interface
4 with safety systems, like containment isolation valves that
5 are safety. So we have to look at the interfaces and make
6 sure there are not adverse interactions.

7 MR. DHIR: Excuse me. Where does the PRA chart
8 come in?

9 MR. HOXIE: The passive residual heat removal
10 system, for me, is more of an issue for the primary system
11 people.

12 MR. CATTON: That's something that we would --

13 MR. DHIR: Because the plant systems people tell
14 us it's the containment.

15 MR. CATTON: Jack, it looks like you should check.

16 MR. HOXIE: We will take that under advisement.

17 MR. CATTON: It actually is out in the
18 containment, I guess. Is the IRWST your responsibility?

19 MR. HOXIE: Certainly, for example, the sparger
20 loadings. There's a shared responsibility.

21 MR. KUDRICK: Basically, the way we view it is
22 that like on IRWST, anything that goes into the IRWST and
23 communicates with the containment, the response of the
24 containment would be ours. With respect to the response of
25 the systems that cause the energy to be driven into the

1 IRWST would be Reactor Systems Branch.

2 I think we do have a close interrelationship, so
3 that we're not going to have these gaps in our review.

4 MR. CATTON: We've had a number of questions on
5 how they model the IRWST because of stratification and
6 things like that. V.J. has had some concerns about the heat
7 transfer coefficients and the possibility of critical heat
8 flux being exceeded. We're not really sure where to pursue
9 those. We know where to pursue them with Westinghouse. We
10 just go to Mr. Butler.

11 MR. HOXIE: You're talking about in terms of
12 stratification. Are you talking about stratification in the
13 IRWST?

14 MR. CATTON: Yes. These things wind up being tied
15 together. The heat removal through the PRHR gives you the
16 stratification. The surface temperature coupled to the
17 containment. So the whole thing becomes much more coupled
18 than in the past.

19 MR. DHIR: There is no database and they have done
20 a few experiments with entirely different geometry.

21 MR. KUDRICK: You can always ask us the question
22 and if it's not us, we're going to find somebody that's
23 going to respond.

24 MR. CATTON: Okay.

25 MR. HOXIE: I think you have heard many of these

1 things today, but we have lots of uncertainties in the way
2 this new containment design will perform. Particularly, one
3 of our objectives is to understand how these passive systems
4 perform. As an example, I threw up three bullets. What is
5 what are the regimes inside the containment; are we in a
6 free convection, mixed convection or forced convection; how
7 good are the experiments that back that up.

8 So you're starting inside the containment. Moving
9 outside the shell there is the business of the water
10 coverage that was discussed exclusively a lot right after
11 lunch.

12 MR. CATTON: Extensively.

13 MR. HOXIE: Thank you. The third one, air flow in
14 the containment annulus, Wolfgang had a lot of questions
15 about. So those are a sampling of some of the concerns that
16 we have as to how this works.

17 Other things about this design are the
18 stratification. This plant doesn't have any forced mixing
19 systems that are safety grade. We're worried about the
20 condensation in the presence of non-condensibles. In the
21 DBA case, it's mostly air.

22 The ability to turn over the re-flood peak. Our
23 calculations are the things that we've seen running some of
24 our old tools, like CONTEMPTEL P-28. The first peak on this
25 plant looks like any large PWR dry containment and where

1 you're really depending on this new system is for it to turn
2 around the second peak. So we have to convince ourselves,
3 like Westinghouse said today, that that second peak was not
4 the limiting one, but that's based on their calculation. We
5 have to convince ourselves that those calculations are,
6 indeed, valid.

7 The last one, long-term adverse containment
8 conditions. Because of the passive nature of the primary
9 systems, it's not clear that they'll be able to achieve a
10 sub-cooled condition. Therefore, out of a break, you would
11 have continued steaming. Therefore, you may be at higher
12 pressures and temperatures for maybe a matter of days. That
13 leads to concerns, especially maybe like the equipment
14 qualification concerns.

15 MR. CATTON: Penetrations.

16 MR. KUDRICK: It's just an extended adverse
17 condition that we haven't encountered up to now.

18 MR. CATTON: You also have to keep an open mind
19 about the stratification.

20 MR. KUDRICK: Yes.

21 MR. CATTON: It's going to be a lot hotter on the
22 top than down below.

23 MR. KUDRICK: Correct.

24 MR. HOXIE: The other thing, as you saw on that
25 other slide, is we'll be doing an acceptance review of

1 WGOthic. Just in a very broad sense, we'll be looking at
2 the models, especially the CLIMES model that they have put
3 in which models the heat transfer across the shell, because
4 that's a unique feature of this plant.

5 We'll be looking at the heat and mass transfer
6 correlations and whether there's an experimental base for
7 them over the range that they're used. That leads right
8 into the relevant experimental database, the prototypicality
9 of the data, the completeness of the test matrices that they
10 ran. As you saw, we also have an extensive effort going on
11 in the scaling, although we're going to have. We've looked
12 at it. I think the Committee has -- from RES there were
13 some ERI reports, Energy Research, Inc., which did some
14 initial work. As I said, we're now starting in with Sandia
15 to do some additional work.

16 MR. WULFF: We were given one report that had
17 serious problems. I think I made comments on that.

18 MR. HOXIE: The main author is Mohsen Khatib-
19 Rahbar.

20 MR. CATTON: We know him.

21 MR. HOXIE: We have, as I had mentioned before,
22 the WGOthic piece. We'll be doing NRC confirmatory analysis
23 using CONTAIN. The last bullet just mentions we haven't
24 ever used WGOthic in a licensing action before. So it's
25 more than just unique. We have to look at the whole

1 shooting match.

2 Into the severe accident part of the review,
3 that's separate and it's a large effort. Our guiding
4 document on that is SECY 93-087. Here we're going to see
5 what we can do to benefit from the work that was done on the
6 evolutionary plants; for example, on the CE System 80+, some
7 important sequences were the steam generator tube rupture
8 and inter-system LOCA. Those are important containment
9 bypass sequences.

10 Similarly, I think they will be on the AP-600; in
11 other words, see some similarities. Hydrogen control, the
12 use of igniters in the CE System 80+. Westinghouse has
13 proposed igniters. Core-concrete interaction, fuel-coolant
14 interaction. We will see what we can. These are tough
15 issues, but we have faced them one time now at least in the
16 CE System 80+ on a PWR.

17 Some of the important deviations that we see,
18 though, and where we will be applying some additional new
19 ground is in the external cooling of the reactor pressure
20 vessel. Again, in severe accident space, under severe
21 accident conditions, we have to worry about the
22 effectiveness of the heat sink or being able to reject heat
23 through the containment shell.

24 The last item is the power supplies for the
25 igniters. Coming off the evolutionary review, for example,

1 the CE System 80+ had their igniters backed by roughly four
2 sources; off-site, gas turbine, diesels, DC. This plant
3 does not have DC igniters and has no gas turbines. So it's,
4 to some extent, two sources less than CE.

5 MR. CATTON: Is anybody considering using the
6 Siemens-type igniter that is self-contained with its own
7 battery?

8 MR. KUDRICK: As you know, EPRI has the report on
9 the PAR system, the autolytic catalytic recombiner.

10 MR. CATTON: I mean the igniter. They have an
11 igniter that has a catalytic element that kicks it off.

12 MR. KUDRICK: On the same principal as the power
13 system. They have not proposed that as of now.

14 MR. HOXIE: I'm commenting here on what's on the
15 docket.

16 MR. CATTON: I understand. I was just curious.

17 MR. DHIR: Is this flooding of the cavity being
18 considered?

19 MR. CATTON: Right under deviations, that next
20 bullet.

21 MR. HOXIE: Absolutely.

22 MR. KUDRICK: That's what we mean by the external
23 cooling.

24 MR. DHIR: Who is going to do the work for you?

25 MR. HOXIE: Westinghouse turned in a phenomenology

1 report. It's WCAP-13388. We've had it --

2 MR. CATTON: Could you get that to us?

3 MR. HOXIE: Sure.

4 MR. CATTON: We'd like to take a look at that.

5 MR. HOXIE: I'll take a note. We're having Sandia
6 review that report. That was on the original bar graph.
7 The third one was that phenomenology.

8 Again, in severe accident space, you have
9 different conditions and, in general, a different complement
10 of equipment. With severe accidents, if you've got a piece
11 of equipment, you take credit for it and do what you can
12 with it. But beyond that, many of the items that would be
13 listed here under understanding the performance would be
14 similar to the ones that were in the DBA slide.

15 However, in some of the unique things, the
16 stratification, now we have to worry about stratification
17 with air and hydrogen, a considerable amount of hydrogen,
18 and also the effect of that hydrogen on the heat rejection.
19 In other words, it could get in the way, condensation in the
20 presence of a non-condensable gas.

21 MR. CATTON: For Westinghouse, were your helium
22 injection tests, in part, to address this?

23 MR. GRESHAM: Yes.

24 MR. CATTON: But you injected the helium while you
25 had strong steam injection. Did you do any of the helium

1 injection with no steam injection to see what happens?

2 MR. GRESHAM: Yes.

3 MR. CATTON: I'd like to see that.

4 MR. DHIR: Yesterday, last time, you suggested
5 they do one test to validate the cool-down with just helium
6 and steam.

7 MR. HOXIE: To just summarize briefly, we're
8 getting through the evolutionary plants, AP-600 to step to
9 the front of the line. We have concerns about the schedule
10 because it appears to be driven by getting us the
11 information, the documentation of the tests and the
12 verification and validation of WGOthic. But we're going to
13 try to work with them to achieve learning about these things
14 as quickly as we can.

15 The passive designs will benefit from the lessons
16 that we've learned in the severe accident on the
17 evolutionary plants. We're starting out currently with our
18 focus on DBA because of two things. One, because of the
19 unique nature of this heat rejection, and, in DBA space, you
20 need to have a little bit better handle on the uncertainties
21 and margins. So this looks like a tough beginning problem.
22 So that's where we're starting our review.

23 MR. CATTON: Yesterday morning when I opened the
24 meeting I quoted Part 52. I had no idea it was so
25 specific. I had never bothered to read it.

1 MR. PIPLICA: Chris, on the documentation of the
2 tests, we're sending you the quick look reports. It's a way
3 of us getting the data to you.

4 MR. HOXIE: That makes this -- there's a big --
5 under the PCCS, it looks like a big gap. I think Gene's
6 point is that we have been getting right along -- in phase
7 two, there were 12 matrix tests and we have now received
8 quick looks on all of those.

9 MR. KUDRICK: Explain what a quick look contains.

10 MR. HOXIE: A quick look report has pretty much
11 the raw data from the test. In other words, thermocouple
12 readings.

13 MR. CATTON: Still in millivolts?

14 MR. HOXIE: No. They're converted to
15 temperatures. It doesn't have any interpretation or any
16 analysis. So they're a start, but I'm hoping that the test
17 data report will go beyond that.

18 MR. KUDRICK: We are using that to go forward with
19 our CONTAIN efforts, because that does represent basic data.
20 But it's limited because of the lack of evaluation.

21 MR. PIPLICA: Can I ask you what sort of
22 evaluation you would expect to see in the final test data
23 report? What level of detail?

24 MR. KUDRICK: I don't know if we can respond to
25 that. Typically, what you do is you look at the data and

1 you evaluate it and you try to understand what happened
2 within the test and why what you're doing on your AP-600
3 design is supported by that information.

4 MR. CATTON: The good Dr. Hochreiter told us we're
5 going to take the CMT data and grind it to dust. Are you
6 going to do the same thing here?

7 MR. GRESHAM: I'm a little less violent than Larry
8 is, but we're going to study it in great detail, yes.

9 MR. ZUBER: Grind it in gold dust.

10 MR. CATTON: I used the word "gold." He just used
11 the word "dust."

12 MR. GRESHAM: I'll try to differentiate between
13 what level of evaluation goes in the test data report as to
14 what goes in the FCCS test analysis report that will be
15 coming out about six months later.

16 MR. KUDRICK: I think one of the questions that
17 was discussed earlier in the morning is that we need to have
18 a thorough understanding of exactly how those tests are
19 going to be applied to the AP-600. I think that through
20 dialogue -- I mean, what are you expecting to get out of
21 those tests? What level of validation of the WGOthic code
22 and then how are you going to use that into the AP-600
23 analysis? These are questions that have to be resolved.

24 MR. CATTON: We agree. Thank you very much.
25 Before we close, I would like each of you to write me a

1 report.

2 MR. ZUBER: May I make a comment on this?

3 MR. CATTON: Yes. I'll ask each of you for
4 comments.

5 MR. ZUBER: No, no. Just on the last --

6 MR. CATTON: Do you want me to --

7 MR. ZUBER: No, no. I want just to make a comment
8 on the staff presentation.

9 MR. CATTON: Fine.

10 MR. ZUBER: I'd like to compliment you. It's a
11 nice presentation. I see that I'm in good company because
12 many of your concerns were identical to the concerns we
13 voiced here. I think you prepared these notes in Washington
14 without any consultation. We see that we have kind of a
15 convergence of our concerns and I think this is very
16 comforting for us, at least for me, and I think I can speak
17 for the rest of the group. It was a nice presentation and
18 thoughtful presentation.

19 MR. CATTON: And I'd like to thank both the staff
20 and particularly Westinghouse for some rather candid
21 discussions.

22 MR. WULFF: We don't discuss GOTHIC.

23 MR. CATTON: Not this time. Next time. GOTHIC is
24 pretty far downstream. So I think we can wait. We probably
25 won't be able to make the 6:00 flight anyway, if anybody

1 would like to stay.

2 MR. DHIR: We can make it.

3 MR. CATTON: I'd like to thank everybody.

4 Consultants, send me reports. With that, we'll adjourn.

5 [Whereupon, at 4:01 p.m., the Committee was
6 recessed.]

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REPORTER'S CERTIFICATE

This is to certify that the attached proceedings
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Commission
in the matter of:

NAME OF PROCEEDING: ACRS Thermal Hydraulic Phenomena

DOCKET NUMBER:

PLACE OF PROCEEDING: Monroeville, PA

were held as herein appears, and that this is the
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Jon Hummley

Official Reporter
Ann Riley & Associates, Ltd.

**NRC's Presentation on
AP600 Containment and Severe Accident
Testing and Analysis
to the ACRS
Thermal-Hydraulics Subcommittee**

by

Jack A. Kudrick

Chris L. Hoxie

Containment Systems and
Severe Accident Branch, NRC

March 16, 1994

Introduction and Agenda

- o Review Schedule

- o Organization of Review
 - DBA
 - ▶ Unique Licensing Considerations for a Passive Design

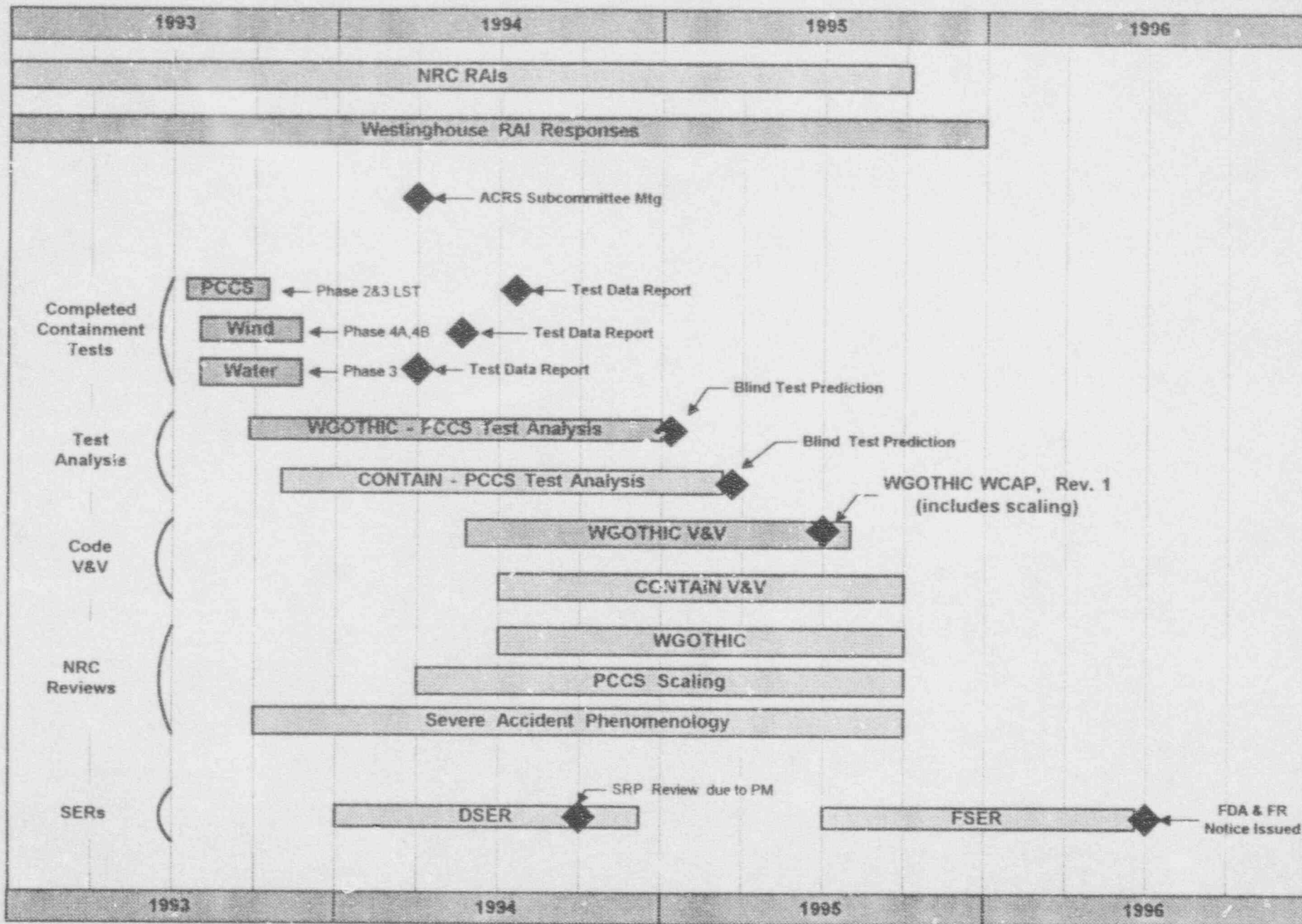
 - Severe Accidents
 - ▶ Unique Licensing Considerations for a Passive Design

- o Summary

Overview

- o Previously Staff Priority Directed at Evolutionary Plants
- o Evolutionary Plants Now Nearly Complete
- o AP600 Now Highest Priority
- o Severe Accident Review Will Not Differ Substantially from Our Review of Severe Accidents in Evolutionary Designs
- o Staff Effort to Focus on DBA Considerations

SCSB's Best Estimate of AP600 Design Review Schedule



DBA Review

Standard Review Plan

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Δ 's

- o Passive Systems
- o Unique Heat Removal Concept
- o No Safety-Related AC Power
- o No Containment Sprays
- o DBA Recombiners; no Safety-Related AC
- o Safety / Non-Safety System Interface

Uncertainties in Containment Performance

(DBA Emphasis)

- o Passive Systems
 - Understand System Performance
 - ▶ Mixed Convection in Containment Interior
 - ▶ Water Coverage on Exterior of Containment Shell
 - ▶ Air Flow in Containment Annulus

- o Unique Design Issues
 - Stratification
 - Condensation in Presence of Non-Condensable Gases (AIR)
 - Ability to Turn Over Reflood Peak
 - Long Term Adverse Containment Conditions

Verification of Analytical Tools

(WGOTHIC)

- o Acceptance Review for WGOTHIC:
 - Code Models (esp. CLIMES)
 - Heat and Mass Transfer Correlations
 - Relevant Experimental Database
 - ▶ Prototypicality of Data
 - ▶ Completeness of Test Matrix
 - Scaling
- o Confirmatory Analysis Using CONTAIN
- o First Use before NRC in a DBA Licensing Action

Severe Accident Review

- o SECY 93-087

SIMILAR to Evolutionary Plant Reviews:

- o Containment Bypass Sequences
 - SG Tube Rupture
 - Inter-system LOCA
- o Hydrogen Control (Igniters)
- o Core-Concrete Interaction
- o Fuel-Coolant Interaction

But with Some Important DEVIATIONS:

- o External Cooling of the Reactor Pressure Vessel
- o Heat Transfer through the Containment Shell
- o Igniters - Power Supplies

Uncertainties in Containment Performance

(Severe Accident Emphasis)

- o Passive Systems

- Understand System Performance

- o Unique Heat Removal Concept

- Stratification
(Air and Hydrogen)

- Condensation in Presence of
Non-Condensable Gases
(Air and Hydrogen)

Summary

- o AP600 Now Highest Priority
- o Schedule Appears to be Driven by:
 - * Documentation of Tests
 - Verification and Validation of WGOTHIC
- o Passive Designs will Benefit from Lessons Learned in Severe Accidents on Evolutionary Plants
- o Review of DBA is Current Focus Because Uncertainties in the Performance of the Unique Passive Heat Removal System