U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: EXAMPLE OF PERFORMANCE ASSESSMENT SUPPORT TO DECISION MAKING

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ARLINGTON, VIRGINIA
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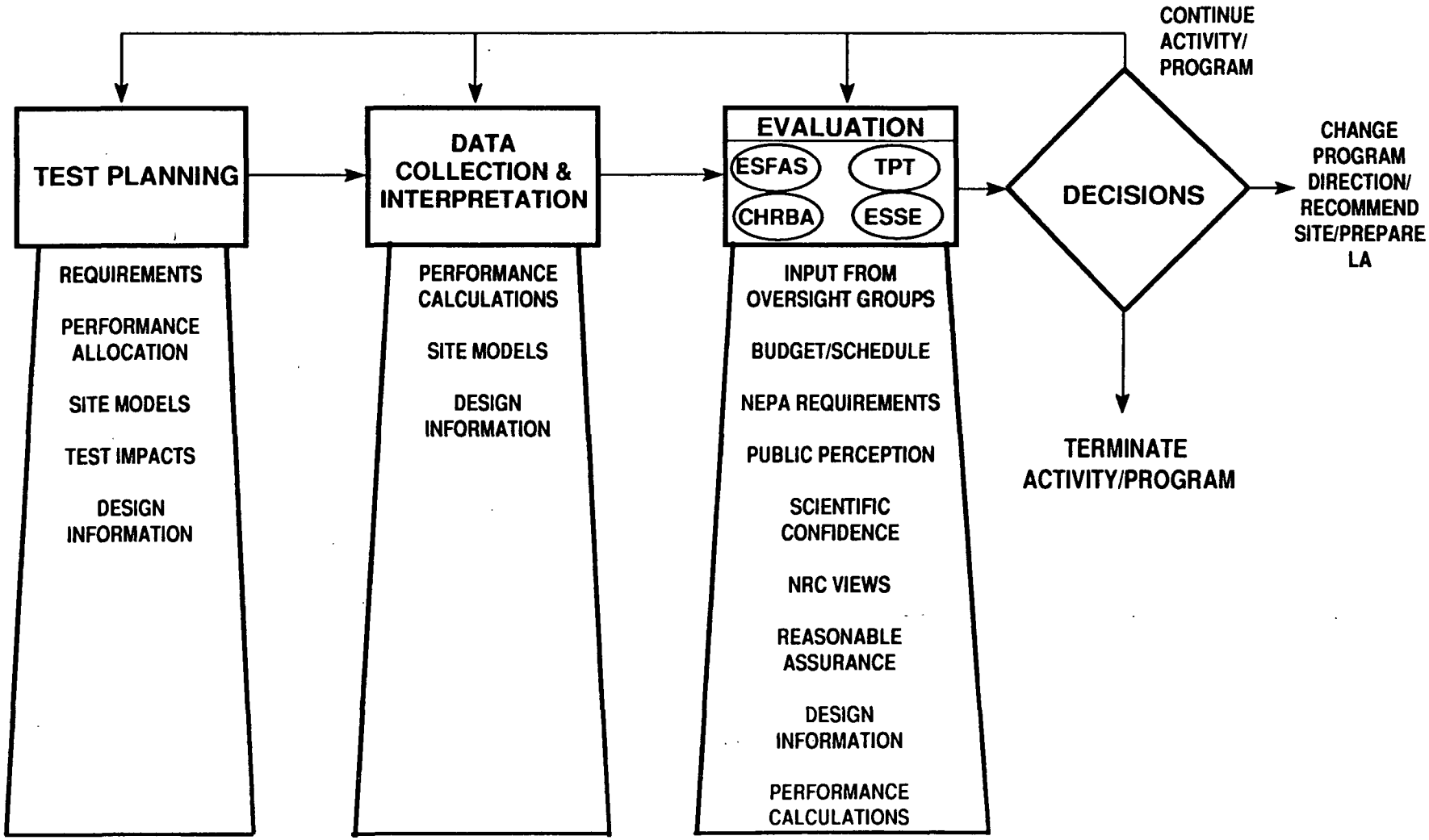
EXAMPLES OF PA SUPPORT TO DECISION MAKING

- PERFORMANCE ASSESSMENT IS ONE OF SEVERAL TECHNIQUES WHICH PROVIDE IMPORTANT INPUT INTO DECISIONS
  - THE CRITERIA APPROPRIATE TO SUPPORTING INDIVIDUAL DECISIONS ARE DEPENDENT ON THE NATURE OF THE PROBLEM
- THIS PRESENTATION WILL DESCRIBE EXAMPLES OF THE USE OF PA IN SEVERAL DIFFERENT TYPES OF DECISIONS
  - PLANNING AND REGULATORY STRATEGY DEVELOPMENT
  - SUPPORT FOR SPECIFIC RECOMMENDATIONS (e.g., TPT, CHRBA, ESFAS)
  - ANTICIPATED UTILITY OF PA IN FUTURE PROGRAMMATIC DECISIONS SUCH AS ESSE

PERFORMANCE ASSESSMENT ROLE ON BUILDING THE BASIS FOR MAKING DECISIONS



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EXAMPLES OF PA SUPPORT TO DECISION MAKING

- INITIAL DEVELOPMENT OF THE TEST PROGRAM RELIED HEAVILY ON IDENTIFICATION OF DATA NEEDS FROM PA AND DESIGN
  - DATA REQUIREMENTS ARE DEPENDENT ON THE CONCEPTUAL SITE MODEL SELECTED
  - NO ONE PA MODEL WILL PROVIDE THE COMPLETE, NECESSARY, AND SUFFICIENT SET OF DATA
- COMPREHENSIVE PROGRAMS IN ALL AREAS (PA, TESTING, DESIGN) REQUIRE ITERATION BETWEEN MODELS, DATA NEEDS AND TESTS

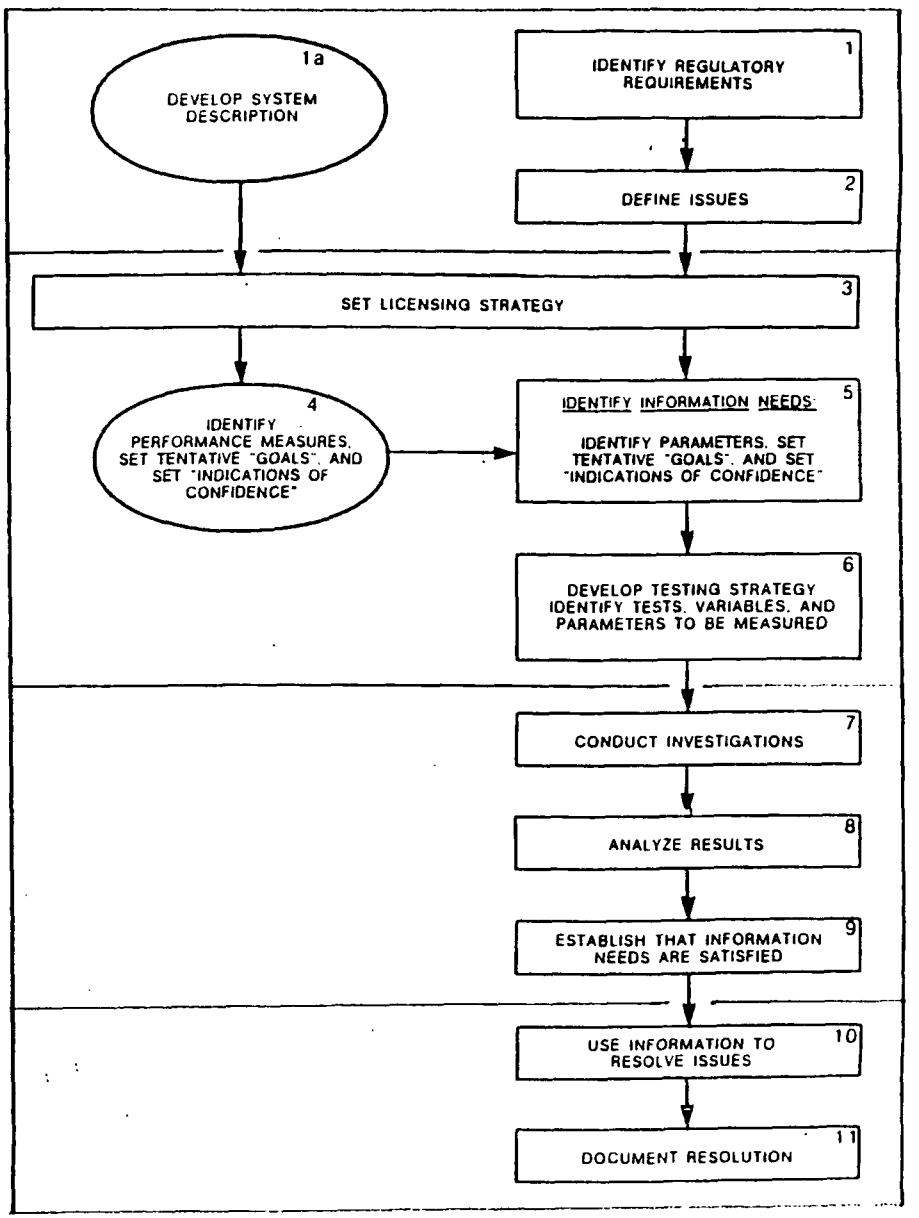
ISSUE RESOLUTION STRATEGY

- **ISSUE IDENTIFICATION**
  (DISCUSSED IN THE SCP)

- **PERFORMANCE ALLOCATION**
  (DESCRIBED IN DETAIL IN THE SCP)

- **DATA COLLECTION AND ANALYSES**

- **ISSUE RESOLUTION**



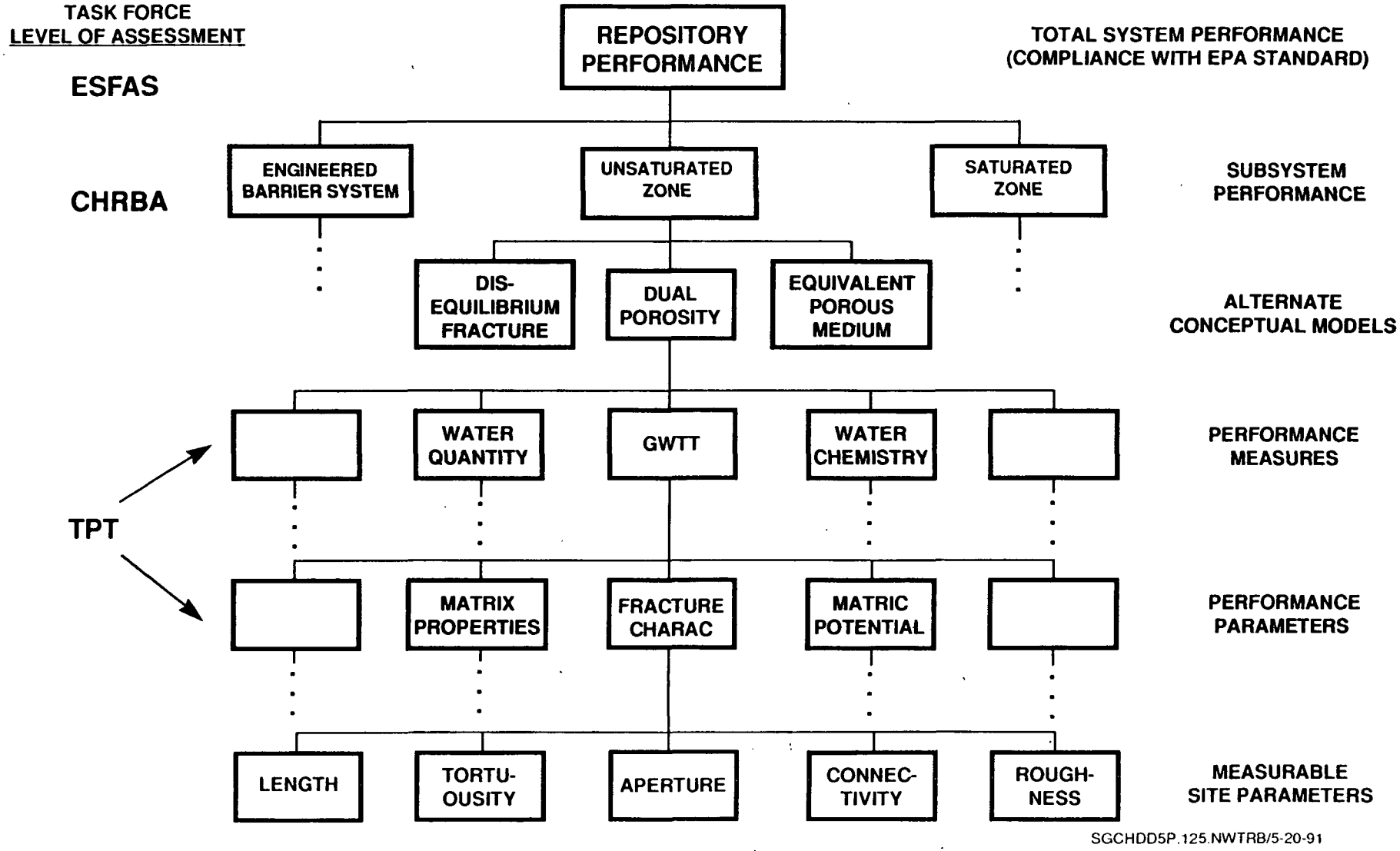
EXAMPLE OF ALTERNATE CONCEPTUAL MODELS/ HYPOTHESIS TESTING TABLE PRECLOSURE TECTONICS (SCP SECTION 8.3.1.8)

1		2	3	4				5
Current representation		Uncertainty and rationale	Alternative hypothesis	Significance of alternative hypothesis				Studies or activities to reduce uncertainty
Model element	Current representation			Performance measure design or performance parameter	Needed confidence in parameter or performance measure	Sensitivity of parameter or performance measure to hypothesis	Need to reduce uncertainty	
Faulting geometry and mechanisms	No hypothesis selected (one or more alternative hypotheses may apply to domain)	High--no data on on subsurface geometry of local faults, no measurements of strike-slip component of movement	Faults in the domain are: Planar-rotational Detachment Part of Walker Lane system	Design-basis ground-motion time histories and corresponding response spectra for facilities important to safety	Medium to high	High--local fault geometries could significantly affect ground-motion and fault slip estimates	High	Reflection and refraction surveys Age and recurrence intervals on Quaternary faults
			Related to a strike-slip fault concealed beneath a detached upper plate	Potential for vibratory ground motion at facilities important to safety	Medium to high	Same as above	High	Quaternary faulting near the site within NE-trending zone
			Normal faults resulting from thermally-driven processes	Probability of faulting with displacements over 5 cm in repository and at location of facilities important to safety	Medium to high	Same as above	High	Detachment faults at or near Yucca Mountain Monitoring current seismicity 3-Dimensional geologic model of site area

PA ROLE IN SPECIFIC ACTIVITIES (TPT, CHRBA, ESFAS)

- THE TASK FORCES HAVE ALL UTILIZED PA AT VARIOUS LEVELS OF DETAIL
- PERFORMANCE ESTIMATES ARE ONLY ONE OF THE IMPORTANT CRITERIA THAT AFFECT THE RECOMMENDATIONS
- PA OFTEN DOES NOT PROVIDE A MEANS FOR DISCRIMINATING AMONG OPTIONS

PERFORMANCE "MODELS" CONTAIN A HIERARCHY OF SUBMODELS AND PARAMETER RELATIONSHIPS. "ASSESSMENTS" CAN BE MADE AT VARIOUS LEVELS, WITH DIFFERING BENEFITS, DETRIMENTS, AND UNCERTAINTIES ASSOCIATED WITH THE LEVEL OF ASSESSMENT



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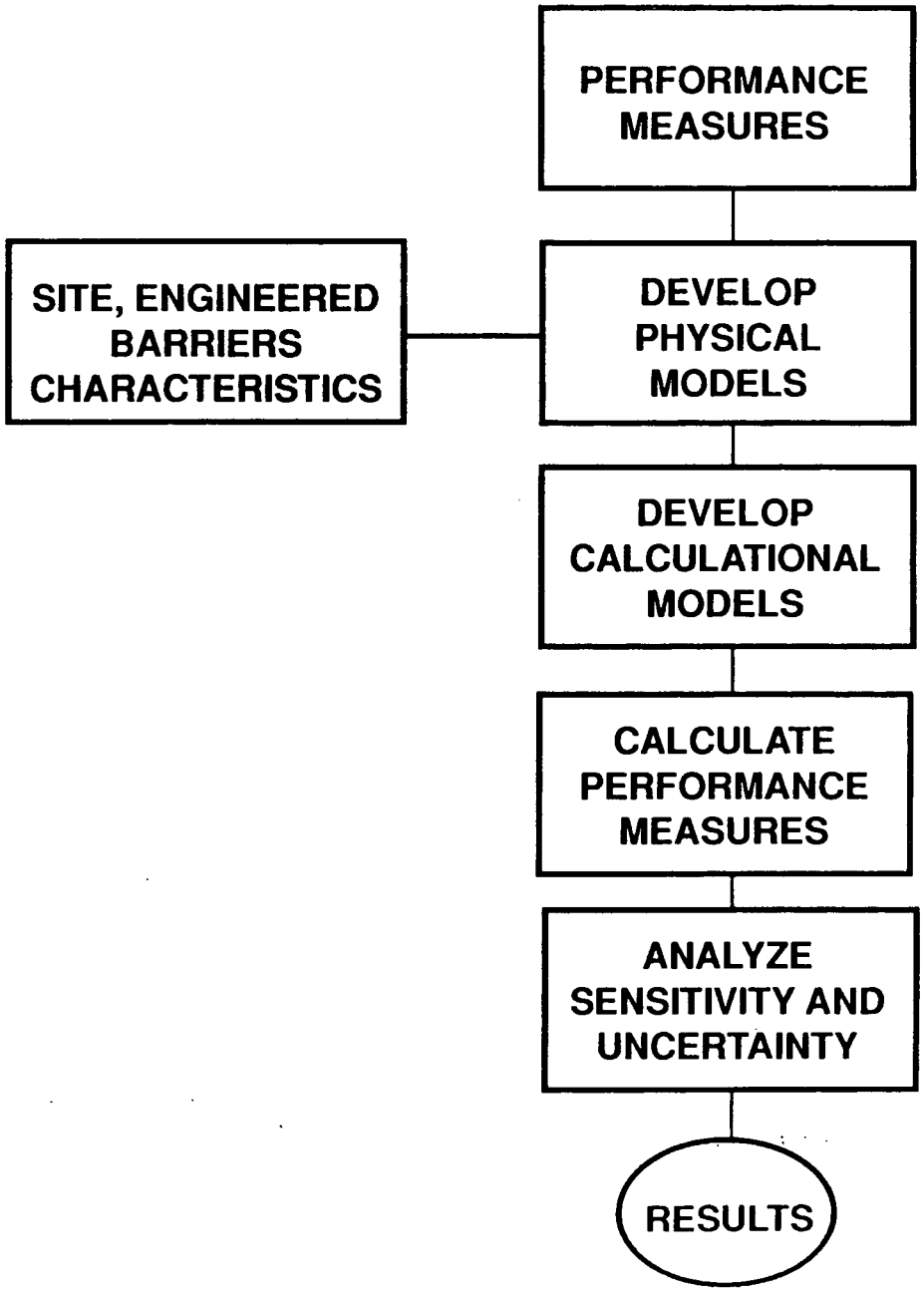
PERFORMANCE ASSESSMENT PROCESS



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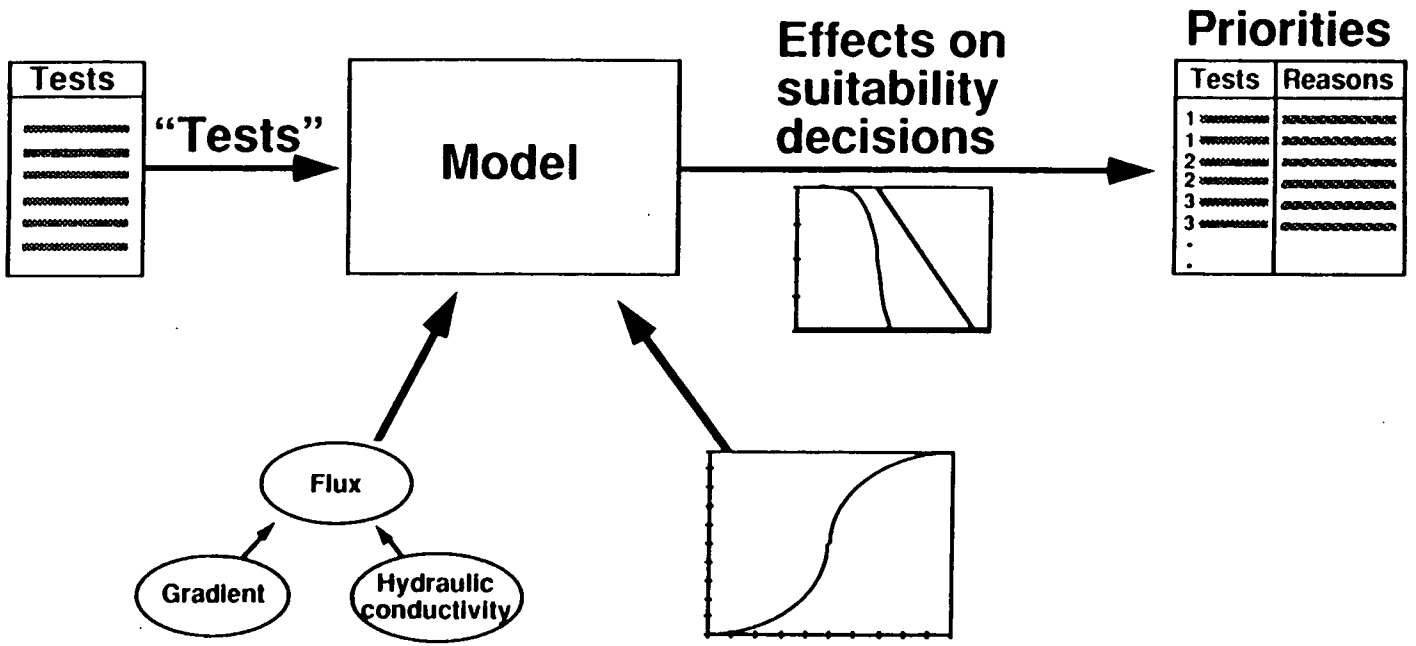
TPT LESSONS LEARNED

- PRIORITIES ESTABLISHED ON BASIS OF TOTAL SYSTEM PERFORMANCE ALONE PROVIDE ONLY PART OF THE PICTURE
  - SITE PERFORMANCE IS ROBUST AND NEW DATA IS UNLIKELY TO CHANGE THIS
  - OTHER REASONS FOR TESTING ARE IMPORTANT (e.g., PRECLOSURE, SCIENTIFIC CONSENSUS)

- PRIORITIES ARE DRIVEN IN PART BY TOTAL SYSTEM CONCERNS
  - GASEOUS RELEASE (PROBLEM WITH REGULATORY CRITERIA?)
  - COMPLEX HYDROGEOLOGY ("UNKNOWN - UNKNOWNS")

- THESE PRIORITIES DO CORRELATE WITH, BUT ARE MUCH MORE LIMITED THAN MOST RECOMMENDATIONS TO DOE FROM OVERSIGHT GROUPS AND NRC

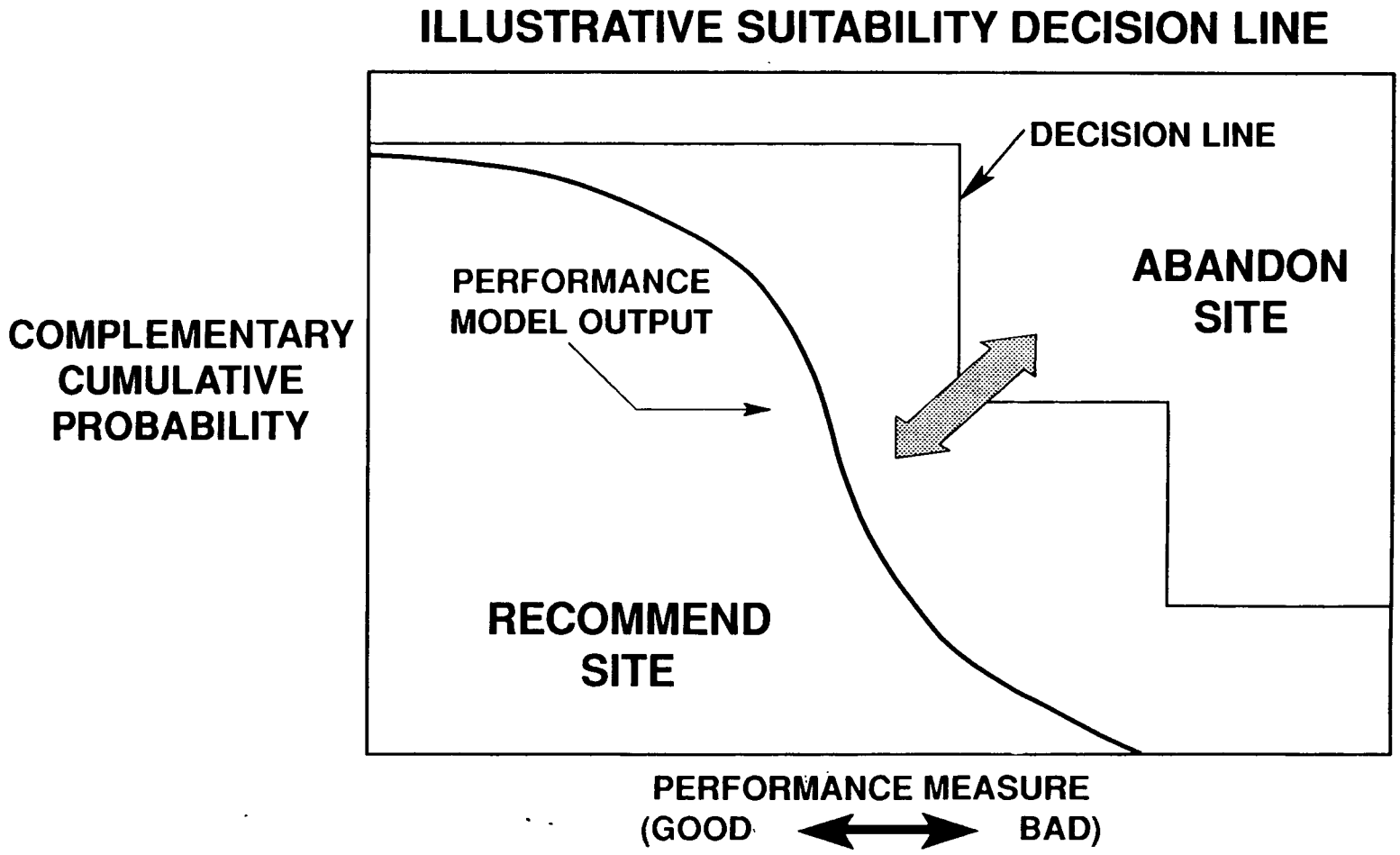
THE TPT TASK FORCE INITIALLY ATTEMPTED TO CONSTRUCT A PERFORMANCE-BASED MODEL WHERE INPUTS WERE ESTIMATES OF PARAMETER VALUES ELICITED FROM EXPERTS



Model structure
- **Parameters**
- **Relationships**

Assessed data
- **Parameter uncertainty**
- **Test accuracy**

TEST PRIORITIZATION TASK FORCE DEVELOPED THE "DECISION LINE" CONCEPT AS BASIS FOR ESTABLISHING TEST PRIORITIES



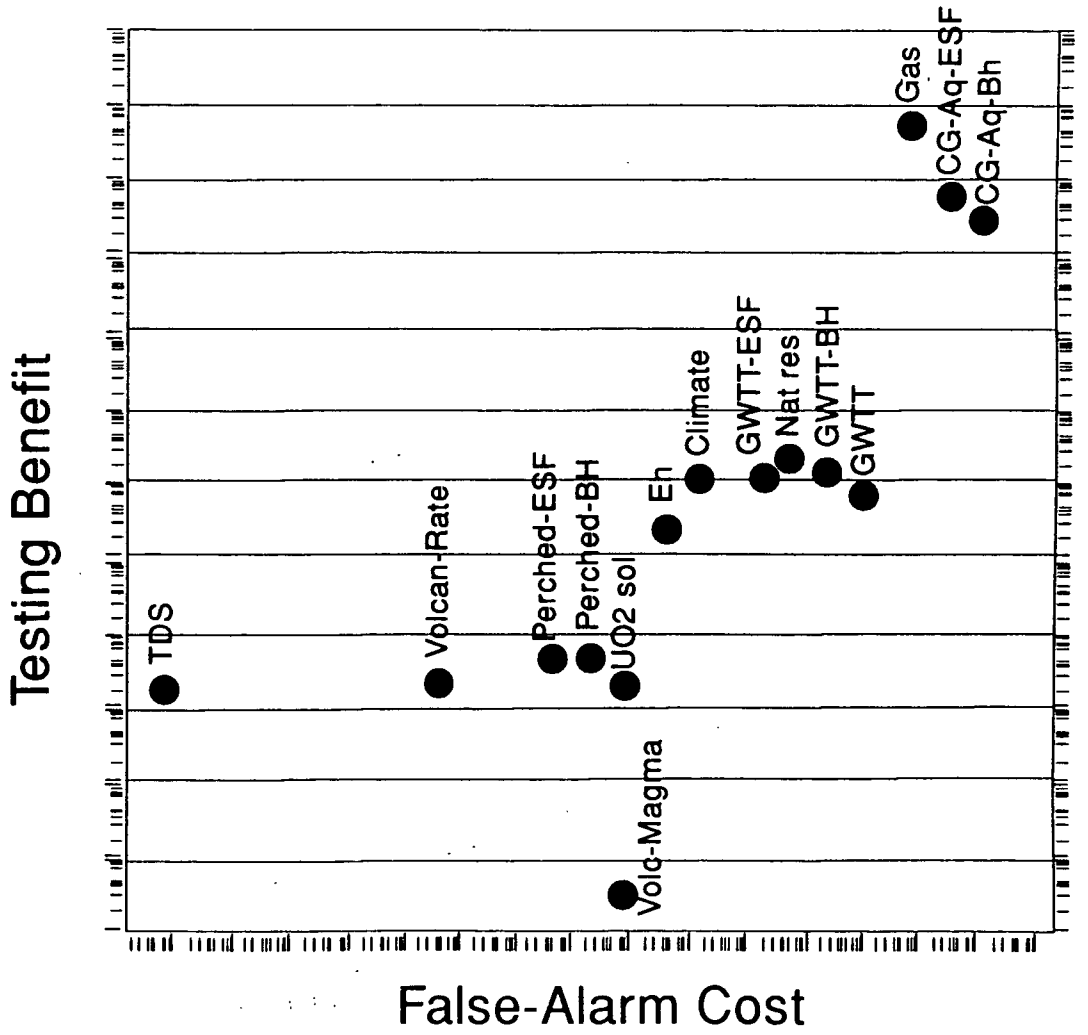
General Priority of Investigative Programs

Testing Benefit

- value of test that currently identifies a suitability concern (true positive)
- ranked according to severity of suitability concern

False Alarm Cost

- negative impact of test that incorrectly identifies a suitability concern (false positive)
- ranked according to severity of impacts due to false positive



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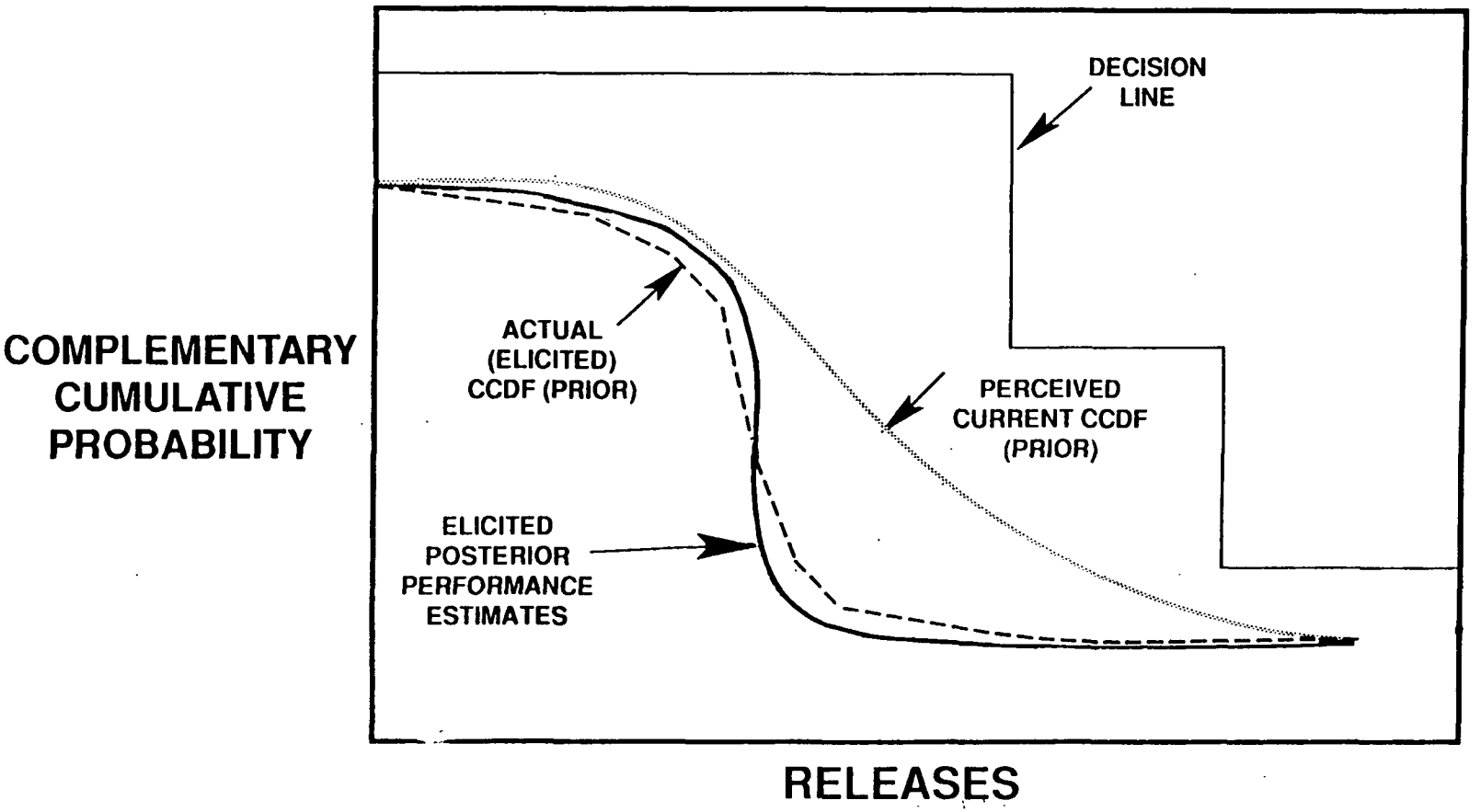
USE OF PA BY CHRBA

- THE CHRBA ALSO INITIALLY ATTEMPTED TO DEFINE TESTING VALUE FROM A NARROW PERFORMANCE–BASED PERSPECTIVE (VOI ANALYSIS)

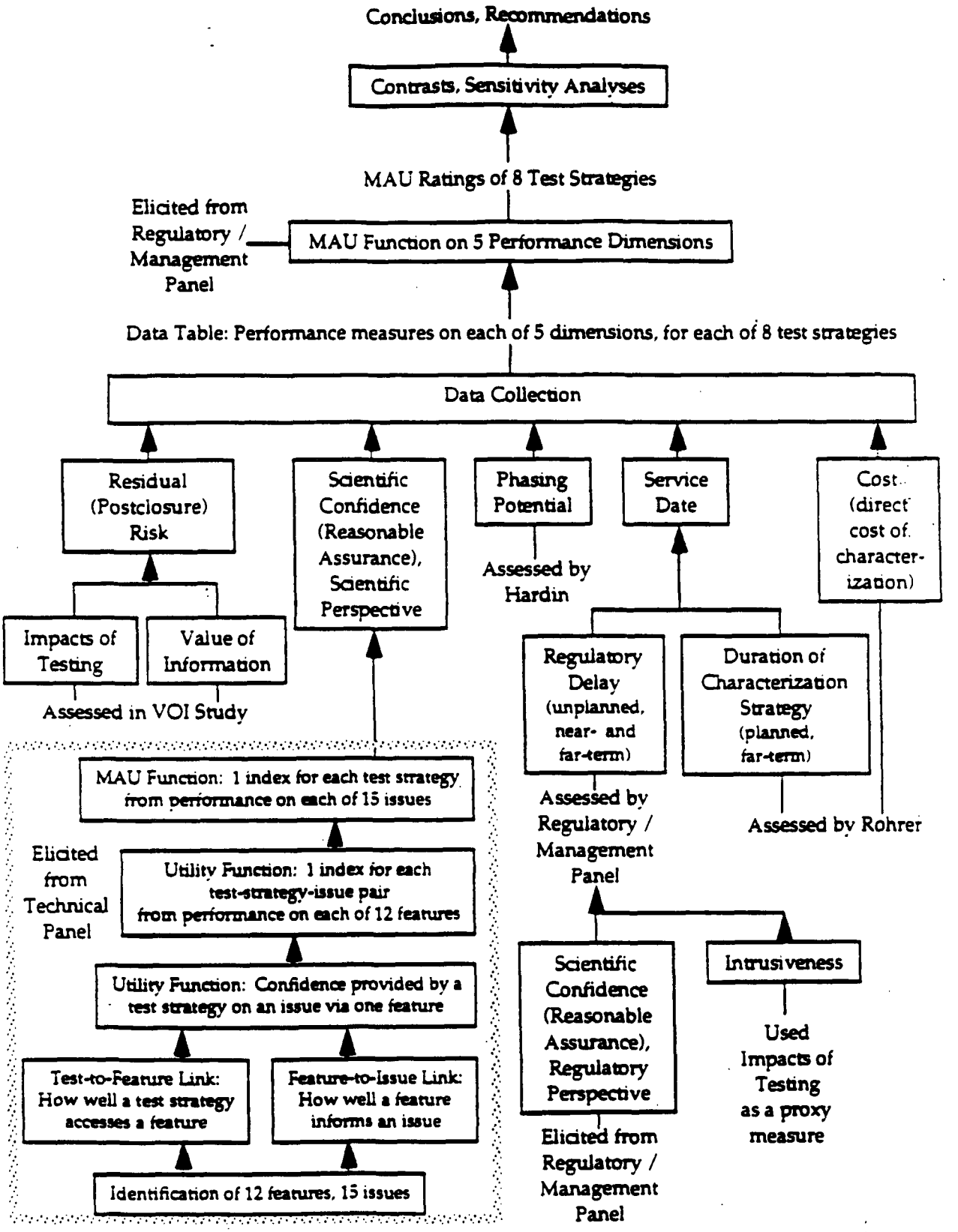
- IT BECAME APPARENT THAT THE TESTING PROGRAM WAS UNLIKELY TO RESULT IN CHANGES TO PERFORMANCE PREDICTIONS THAT ARE SIGNIFICANT ENOUGH TO CAUSE PROGRAMMATIC DECISIONS TO CHANGE

- BECAUSE THE PANEL BELIEVED THAT TESTING HAD VALUE THAT WAS NOT CAPTURED BY THE VOI, A MULTI–ATTRIBUTE UTILITY ANALYSIS WAS INITIATED TO CLEARLY DEFINE THE VALUE

APPROACH DEVELOPED BY CHRBA TO ASSESS TESTING VALUE WAS DEFINED IN TERMS OF IMPROVED PERFORMANCE ESTIMATES OF THE SITE



FLOWCHART OF THE COMPLETE MUA ANALYSIS



PROGRAMMATIC INSIGHTS

VALUE OF INFORMATION

- **TESTING PROGRAM, AS CONCEIVED, IS NOT "PERFORMANCE BASED"**
  - **i.e., THE NEED FOR TESTING IS BASED MORE ON PROGRAMMATIC CONCERNS (e.g., PUBLIC ACCEPTANCE) THAN PROVIDING INFORMATION THAT WILL ACTUALLY RESULT IN IMPROVED SYSTEM PERFORMANCE**

- **EVEN IF HUMAN INTRUSION AND GASEOUS RELEASE ARE TAKEN INTO ACCOUNT (RELEASES > AQUEOUS RELEASES; REFERENCE TPT REPORT) THE VOI FROM TESTING IN THE CHn UNIT IS STILL LOW. THE VALUE OF THIS PARTICULAR INFORMATION IS LIKELY TOO LOW TO CHANGE THE VOI RESULT**

PROGAMMATIC INSIGHTS

VALUE OF INFORMATION (CONTINUED)

- SATURATED ZONE WILL PROBABLY CONTRIBUTE SIGNIFICANTLY TO PERFORMANCE
- POTENTIAL IMPACTS FROM CHARACTERIZATION ON POSTCLOSURE AQUEOUS RELEASES FROM THE TOTAL SYSTEM ARE EXPECTED TO BE LOW

PROGRAMMATIC INSIGHTS

(CONTINUED)

MULTIATTRIBUTE UTILITY

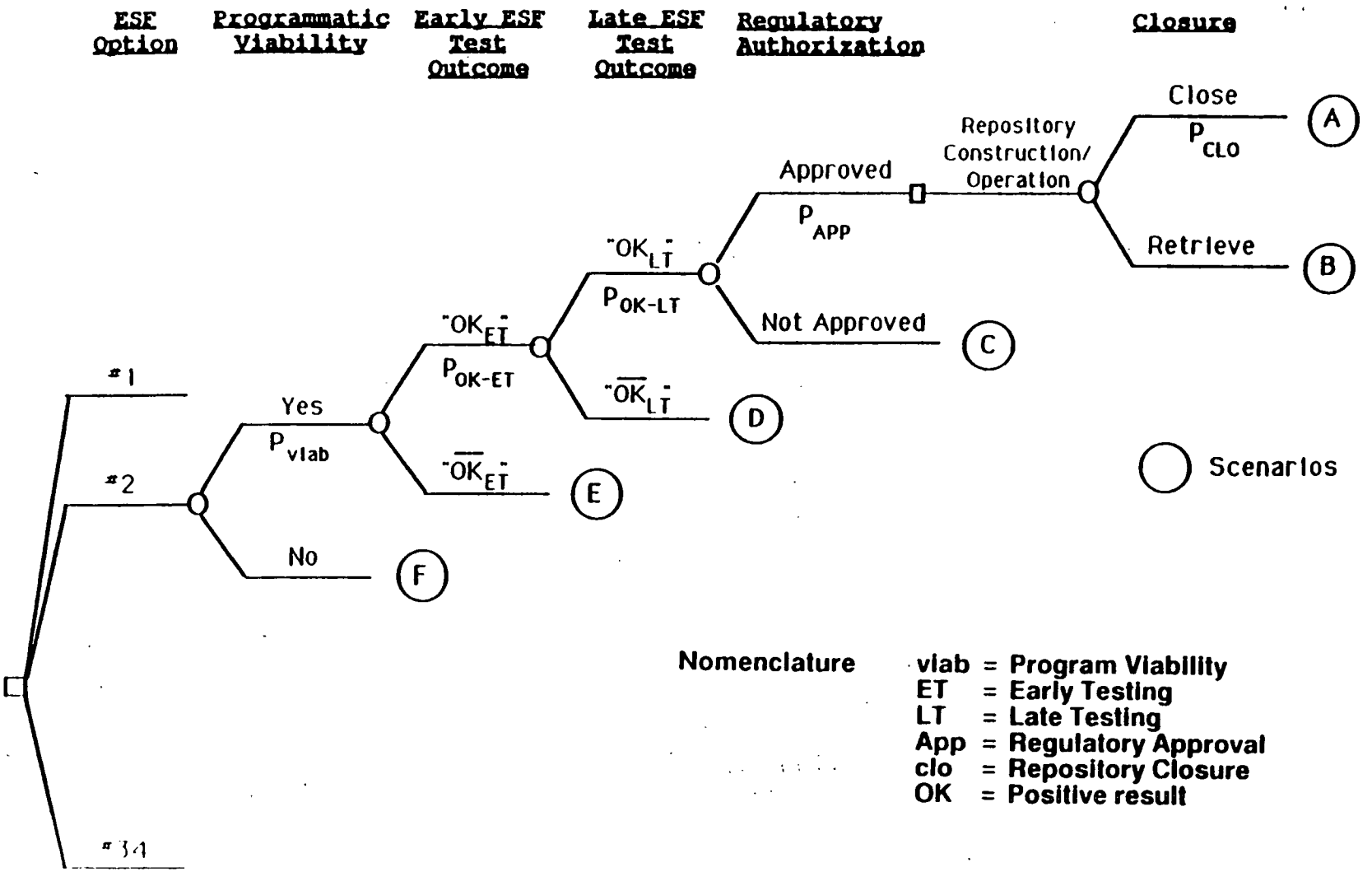
- SCIENTIFIC CONFIDENCE ASSESSMENTS WITH YMP TECHNICAL STAFF INDICATE THAT THE "MAXIMUM LOOK" IS NOT NECESSARY TO ACHIEVE CONFIDENCE, AND SCIENTIFIC CONFIDENCE AS DEFINED CAN BE INCREASED BY EXPLORING OUTSIDE THE REPOSITORY BLOCK
- THE ESF SHOULD BE DESIGNED TO BE CAPABLE OF DRIFTING TO ANY PART OF THE REPOSITORY BLOCK. OTHERWISE, THERE IS A POTENTIAL FOR REGULATORY DELAY IN THE VIEW OF REGULATORY STAFF

USE OF PA BY ESFAS

- ESF ALTERNATIVES STUDY HAD FIVE PRINCIPAL CATEGORIES OF CRITERIA, INCLUDING SEVERAL THAT INCORPORATED PA
- IN THE OVERALL ANALYSIS, PERFORMANCE ASSESSMENT–RELATED CRITERIA DID NOT PROVIDE A MEANS FOR DISCRIMINATING BETWEEN OPTIONS
- MANAGEMENT VIABILITY AND THE PROBABILITY OF REGULATORY APPROVAL WERE THE CRITICAL CRITERIA FOR THE ESF RECOMMENDED OPTIONS

DECISION TREE

THE IMPACT OF THE ESF OPTION ON THE LIKELIHOOD OF IMPORTANT DOWN-STREAM DECISIONS AND UNCERTIAINTIES



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SUMMARY OF DECISION TREE CALCULATIONS

Option		PROBABILITIES {Prog. Viab}		{"OK-ET"}		{"OK-LT" / "OK-ET"}		{Approval}		{Closure}		{Scenario A}		Expected Net Benefit [$ million] *	
B.Case	1	0.55	26th	0.83	18th	0.89	30th	0.78	24th	0.995	30th	0.31	27th	12,080	27th
A1	2	0.73	15th	0.83	11th	0.91	2nd	0.93	4th	0.998	11th	0.51	7th	20,829	7th
A2	3	0.52	31st	0.83	13th	0.90	5th	0.89	9th	0.998	17th	0.35	26th	13,674	25th
A4-1	4	0.74	13th	0.83	16th	0.92	1st	0.87	12th	0.999	4th	0.49	10th	19,684	10th
A5	5	0.58	21st	0.84	9th	0.90	8th	0.85	15th	0.999	7th	0.37	22nd	14,501	22nd
A7	6	0.78	9th	0.83	15th	0.90	17th	0.93	3rd	0.999	3rd	0.54	5th	22,218	5th
B3-2	7	0.79	7th	0.82	25th	0.90	9th	0.92	5th	0.998	13th	0.54	6th	21,990	6th
B3-3	8	0.64	18th	0.83	24th	0.90	18th	0.85	15th	0.998	15th	0.40	19th	15,984	18th
B3-4	9	0.45	34th	0.74	33rd	0.84	33rd	0.67	33rd	0.991	34th	0.19	34th	6,142	34th
B3-5	10	0.58	22nd	0.78	32nd	0.89	24th	0.74	29th	0.996	28th	0.30	29th	11,139	29th
B3-6	11	0.56	24th	0.82	26th	0.90	6th	0.83	18th	0.997	23rd	0.35	25th	13,536	26th
B4	12	0.58	23rd	0.84	5th	0.90	11th	0.81	21st	0.998	8th	0.35	23rd	13,763	23rd
B7	13	0.81	6th	0.85	1st	0.91	3rd	0.89	9th	0.999	1st	0.55	4th	22,579	4th
B8	14	0.51	33rd	0.84	8th	0.90	7th	0.78	25th	0.998	12th	0.30	28th	11,370	28th
C1	15	0.54	28th	0.83	20th	0.90	10th	0.95	1st	0.999	5th	0.38	21st	15,454	20th
C4	16	0.53	29th	0.81	29th	0.89	23rd	0.90	7th	0.999	2nd	0.35	24th	13,725	24th
R11	17	0.56	25th	0.83	21st	0.90	13th	0.70	31st	0.997	25th	0.29	30th	10,981	30th
B.Case	18	0.52	32nd	0.82	28th	0.88	32nd	0.77	27th	0.995	31st	0.29	31st	10,956	31st
A1	19	0.77	10th	0.83	12th	0.89	26th	0.90	8th	0.997	18th	0.51	8th	20,404	8th
A2	20	0.67	17th	0.83	17th	0.89	27th	0.83	18th	0.997	21st	0.41	17th	16,322	17th
A4-1	21	0.77	12th	0.84	3rd	0.90	12th	0.84	17th	0.998	16th	0.49	11th	19,579	11th
A5	22	0.77	11th	0.84	4th	0.90	20th	0.78	25th	0.997	22nd	0.45	13th	17,760	13th
A7	23	0.87	3rd	0.83	14th	0.89	28th	0.90	6th	0.998	10th	0.58	2nd	23,306	2nd
B3-2	24	0.90	1st	0.82	27th	0.89	25th	0.86	14th	0.997	24th	0.57	3rd	23,006	3rd
B3-3	25	0.84	4th	0.83	23rd	0.90	16th	0.80	22nd	0.997	19th	0.50	9th	19,920	9th
B3-4	26	0.55	27th	0.74	34th	0.83	34th	0.66	34th	0.991	33rd	0.22	33rd	7,677	33rd
B3-5	27	0.83	5th	0.79	31st	0.89	31st	0.73	30th	0.996	29th	0.42	15th	16,340	16th
B3-6	28	0.79	8th	0.83	22nd	0.90	14th	0.82	20th	0.997	26th	0.48	12th	19,211	12th
B4	29	0.73	14th	0.84	7th	0.90	15th	0.79	23rd	0.997	20th	0.43	14th	16,921	14th
B7	30	0.89	2nd	0.85	2nd	0.91	4th	0.87	13th	0.999	6th	0.60	1st	24,385	1st
B8	31	0.70	16th	0.84	6th	0.90	21st	0.77	28th	0.997	27th	0.41	18th	15,862	19th
C1	32	0.62	19th	0.80	30th	0.90	19th	0.94	2nd	0.998	9th	0.42	16th	16,759	15th
C4	33	0.59	20th	0.83	19th	0.90	22nd	0.88	11th	0.998	14th	0.39	20th	15,306	21st
R11	34	0.53	30th	0.83	10th	0.89	29th	0.69	32nd	0.995	32nd	0.26	32nd	9,852	32nd

* Assumes benefit of functioning closed repository is $50 billion.

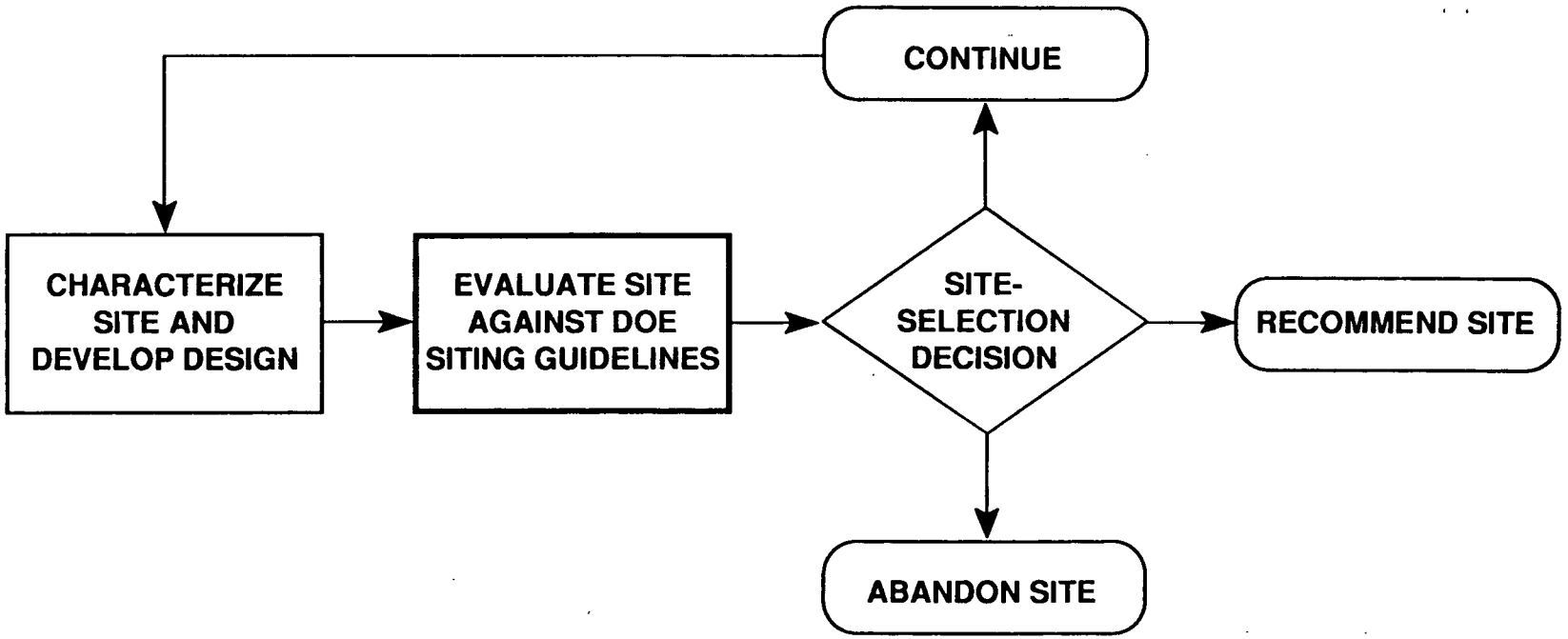
Prelim.prob4 2/26/91

EXAMPLES OF PA SUPPORT TO DECISION MAKING

(CONTINUED)

- ANTICIPATED USE OF PA IN ESSE

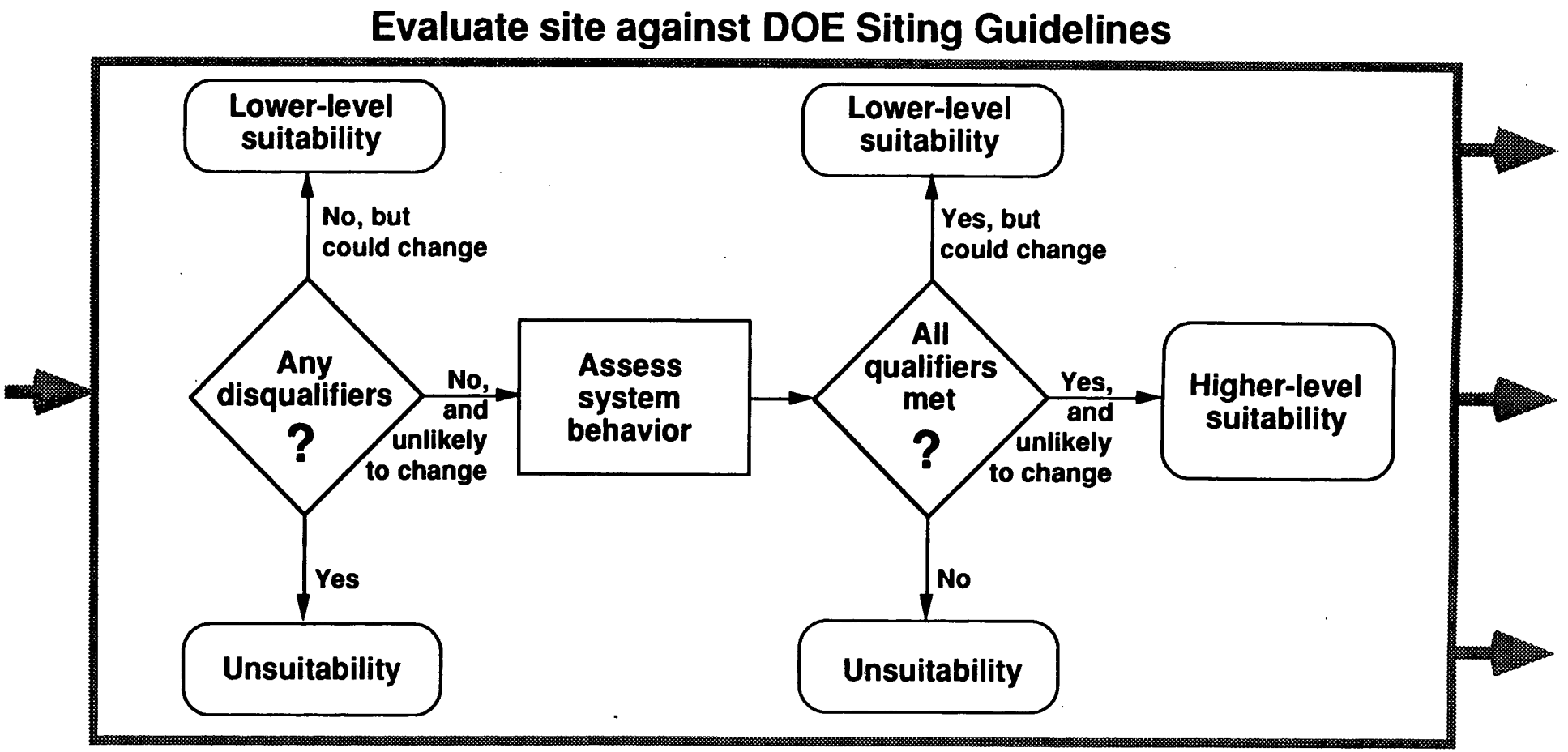
LOGIC FOR EARLY EVALUATION OF SITE SUITABILITY



ELEMENTS OF THE EVALUATION

- EVALUATING DISQUALIFYING AND QUALIFYING CONDITIONS OF 10 CFR PART 960
- MAKING LOWER-LEVEL AND HIGHER-LEVEL FINDINGS REGARDING THESE CONDITIONS
- REEVALUATING WITH UPDATED INFORMATION

THE SITING GUIDELINES PROVIDE A SYSTEMATIC PROCESS FOR EVALUATING SITE SUITABILITY



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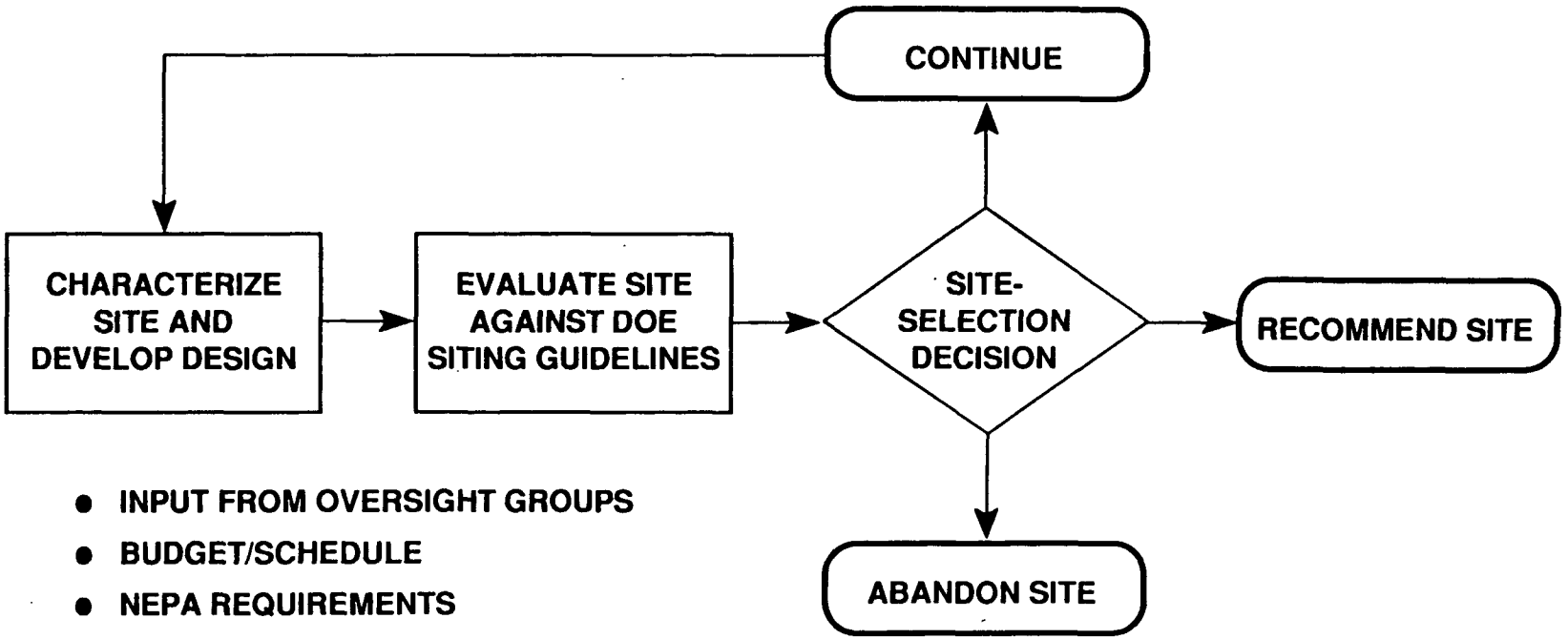
SITE-SELECTION DECISIONS WILL INCORPORATE ADDITIONAL FACTORS



- INPUT FROM OVERSIGHT GROUPS
- BUDGET/SCHEDULE
- NEPA REQUIREMENTS
- PUBLIC PERCEPTION
- SCIENTIFIC CONFIDENCE
- NRC VIEWS
- DESIGN INFORMATION
- PERFORMANCE CALCULATIONS

SUMMARY OF LESSONS LEARNED FROM TASK FORCE APPLICATIONS

- PA IS A VALUABLE TOOL THAT CAN BE APPLIED AT VARIOUS LEVELS OF DETAIL
- PA IS NOT A PANACEA