NIST Response to the World Trade Center Disaster

World Trade Center Investigation Status

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Highlights

- Release of May 2003 Progress Report
- Update on Data Collection Efforts
- Selection of External Experts and Contractors
- Schedule and Challenges
- Status of Component Projects
- Advisory Committee Feedback

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1. Release of May 7, 2003 Progress Report

- Expected coverage and response
- Generated valuable feedback and inputs; validated technical facts
- Suggestions
  - Examine positive aspects of the performance of the buildings as well
  - Recognize that no office building has ever been designed to withstand the impacts of fuel-laden commercial airliners
  - Terminology: “attacks” more appropriate than “disaster”
- Disaster: A sudden calamitous event bringing great damage, loss, or destruction *(Merriam-Webster Dictionary)*

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2. Update on Data Collection Efforts

- Significant progress achieved since May 2003
  - Reports of critical UL tests performed for the supplier of fireproofing materials
  - Tapes of NYPD internal communications concerning WTC terrorist attacks
  - Design of WTC internal radio system and FDNY radio repeater from PANYNJ
  - WTC list of occupants issued security badges by PANYNJ
  - Photos (5616 versus 3100); video clips (4674 versus 3400)
- NIST requests for materials that are currently pending with, or not yet located and/or provided by organizations
  - Original contract specifications for WTC towers
  - Construction logs and maintenance logs for WTC 1, 2, and 7
  - 9-1-1 tapes and logs, transcripts of about 500 first responder interviews (privilege claimed by NYC)
  - Supporting documents for McKinsey & Company's FDNY and NYPD studies
  - Complete set of NYPD records identified in request lists submitted by NIST
  - Contents of aircraft (cabin furnishings, cargo, etc.) that contributed to fires
  - Descriptions of partitions and furnishings in most of the tenant spaces of WTC 2 & 7
- **It is vital that this information be made available to NIST**

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3. Selection of External Experts and Contractors

- Process nearing completion
  - Solicitations issued: 15 (1 replaced w/consultant)
  - Awards made: 6 contracts
    9 experts (3 solicitations)
  - Under negotiation: 3 contracts (anticipate by 9/1/03)
  - Open solicitations: 2 contracts (anticipate by 10/1/03)
  - Solicitation in process: 1 contract (anticipate by 10/15/03)
- Four others hired as expert consultants
  - V. Junker; K. Malley, V. Dunn, J. Hodgens
- Excellent group of contractors and experts to augment NIST in-house capabilities

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World Trade Center Investigation Contract Solicitations

WTC No.	Project	Title	Status	Recipient
1	7	Outside Experts for Occupant Behavior and Evacuation	Awarded 9/30/02 and 10/16/02	D. Mileti, G. Proulx, N. Groner
2	5, 6, 7	Fire Safety Engineering Expertise	Awarded 12/23/02	H. Nelson
3	5	Media, Visual and Database Expert with Experience in Obtaining Visual Materials for the World Trade Center	Hired expert consultant	V. Junker
4	3	Document and Evaluate the Steel Recovered from the WTC Towers	Awarded 6/9/03	WJE Associates
5	7	WTC Investigation Survey Administration and Report Delivery: Questionnaires, Interviews and Focus Group Synopsis	Awarded 6/9/03	NuStats, DataSource, GeoStats, MBC Res Ctr
6	2	Development of Structural Databases and Baseline Models for the WTC Towers	Awarded 2/23/03	LERA
7	1	Analysis of Building and Fire Codes and Practices	Awarded 7/25/03	RJA, SKG, RG
8	7	World Trade Center Investigation First Person Accounts of Egress	Awarded 4/15/03	NFPA
9	6	Fire Endurance Testing of the WTC Floor System	Awarded 7/10/03 Modified 8/22/03	UL
10	2, 5, 6	Outside Experts for Baseline Structural Performance, Impact Analysis, Structural Response to Fire, Collapse Initiation and Probabilistic Assessment of the WTC Investigation	Awarded 6/16/03, 6/23-25/03, 7/3/03	SOM, D. Parks, UC Boulder, Teng Assoc, D. Veneziano/J. Van Dyck
11	2	Analysis of Aircraft Impacts into the WTC Towers	Anticipate by 9/1/03	*TBD*
12	4	Analysis of Sprinklers, Standpipe, Pre-Connected Hoses in WTC 1, 2, 7	Anticipate by 9/1/03	*TBD*
13	6	Development of WTC 7 Structural Models and Collapse Hypotheses	Anticipate by 9/1/03	*TBD*
14	6	Structural Response of WTC Towers to Fire With/Without Impact Damage	Open; closes 8/29/03	*TBD*
15	4	Analysis of Active Fire Alarm Systems, WTC 1, 2, and 7	Open; closes 8/27/03	*TBD*
16	4	Analysis of Smoke Management Systems, WTC 1, 2, and 7	In process	*TBD*

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Use of External Experts in Source Selection

- Use in an advisory capacity:
  - Independent technical review of proposals
  - Screening by NIST for bias due to potential conflicts of interest
  - Use must be posted in solicitation
- Use in evaluation and consensus ranking:
  - Requires determination by agency head that no personnel available from agency or any other federal agency
  - Agency must make reasonable attempts to demonstrate that no suitable federal evaluators can be identified
  - Use must be posted in solicitation
  - DOC procurements rarely use outside evaluators (e.g., use for large construction or IT projects)
  - Evaluation factors related to experience and past performance allow selection of contractor with a proven track record; can be used in lieu of evaluator with expertise in specific field
- Used external experts in advisory capacity for aircraft impact analysis solicitation; too late for use with first-person data collection solicitation

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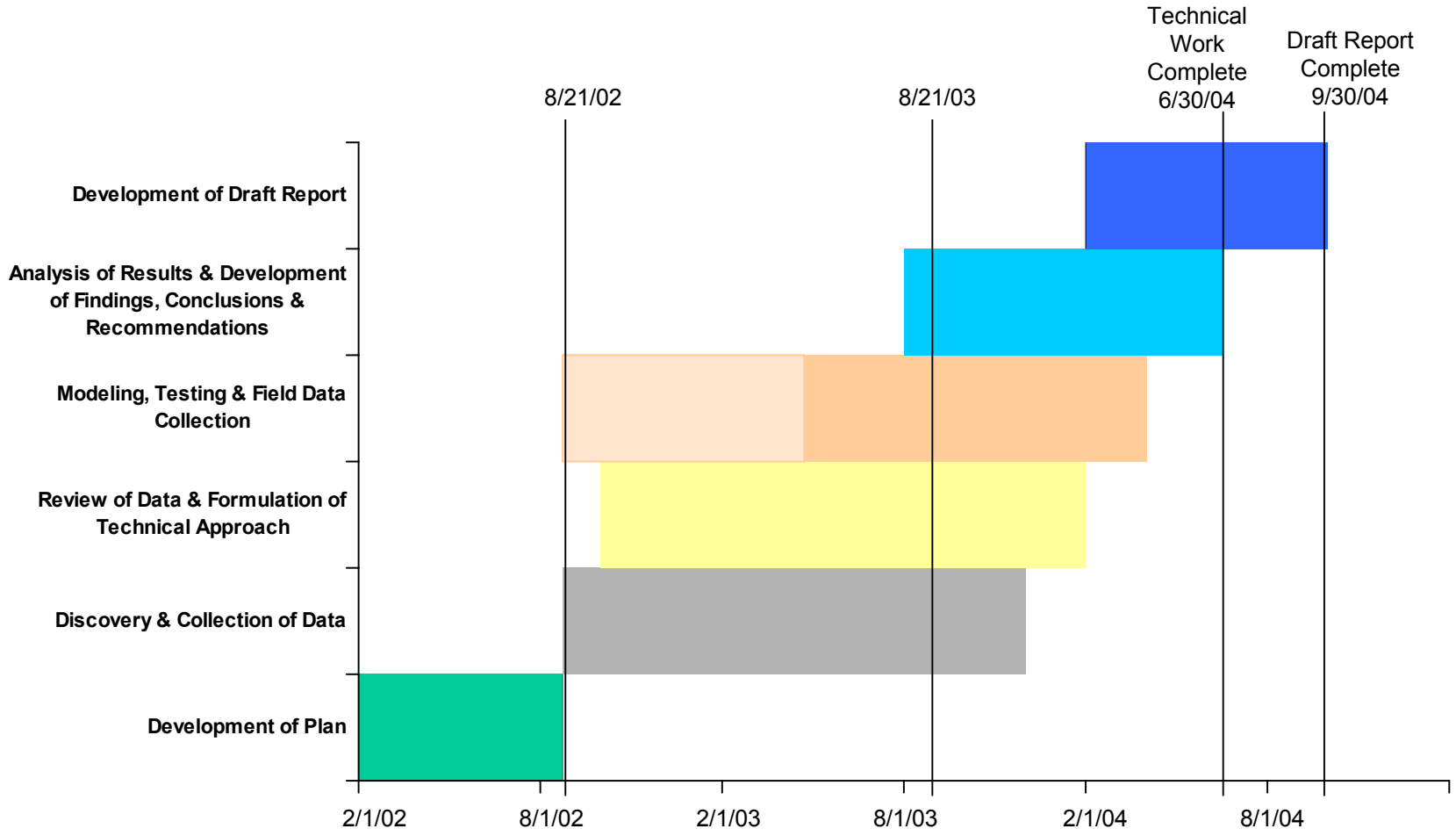
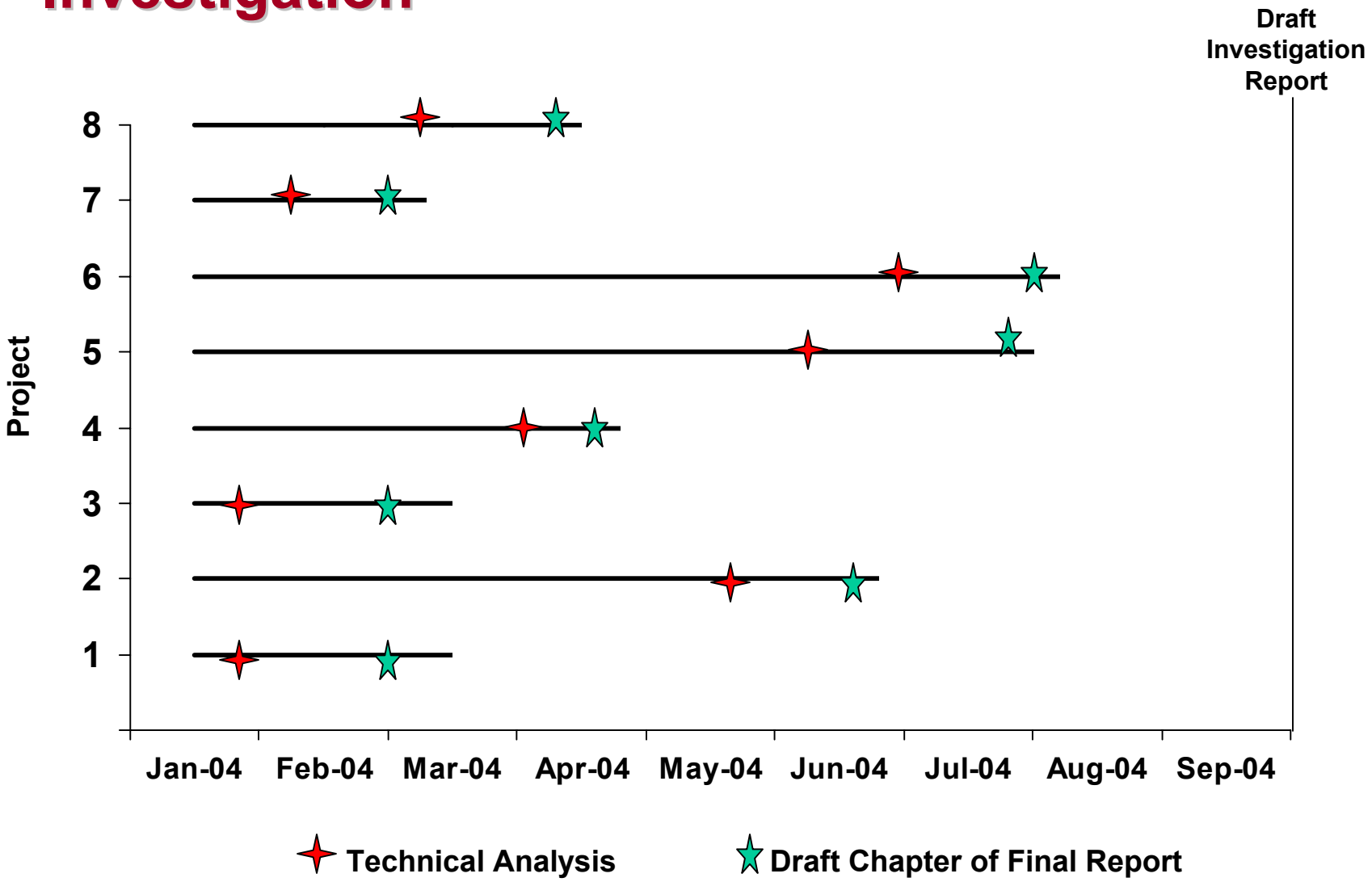
4. Schedule and Challenges: WTC Investigation Workflow



Projected Completion Schedule for WTC Investigation



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Challenges

- Massive amounts of data from external sources; significant amount continues to be identified/received (affecting projects 1, 2, 5, 6 & 8 most)
- Level of complexity in fire-structure modeling and collapse analysis (affecting projects 2, 5 & 6)
- Scope and scale of occupant behavior, evacuation, and emergency response study (affecting projects 7 & 8)
- Process and time for acquiring outside expertise (affecting projects 1, 2, 6 & 7 most)
- IRB and Paperwork Reduction Act (PRA) requirements and process (affecting projects 7 & 8)

5. Status of Component Projects: Key Accomplishments Over Last 12 Months

- Collection and review of massive amounts of data from external sources (over 200 boxes)
- Selection, transportation & identification of steel; increase from 100 to 250 pieces
- Determination of mechanical and metallurgical properties of recovered steel
- Methodology and protocols for first-person data collection on occupant behavior, evacuation, and emergency response
- Methodology for assessing the most probable structural collapse sequence integrating impact, fire, thermal, structural, and collapse analyses
- Interim report on fireproofing procedures & practices for WTC floor system

Key Accomplishments Over Last 12 Months (Contd.)

- Time-sequenced visual analysis of fire and damage to WTC towers
- Fire dynamics and thermal response modeling
- Computational interfaces between fire and structural models and software
- Experimental validation of fire dynamics and thermal-structural models
- Development of structural database and model of WTC towers
- Review of extensive PA and NYPD communications data

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WTC Fire Model Input Study

Two Views of WTC-1 Work Station

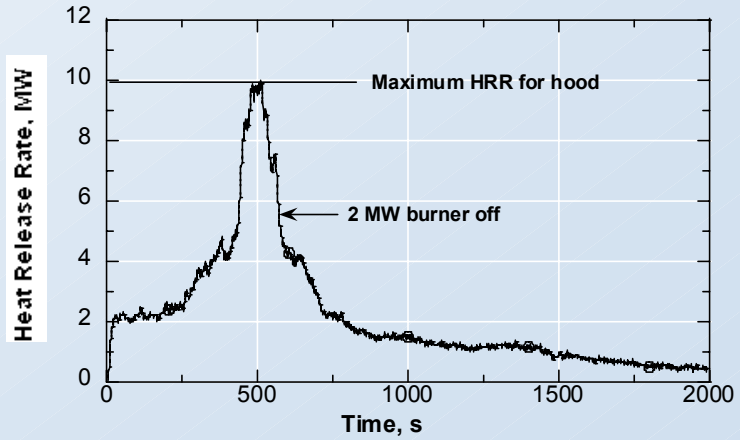
Motivation for workstation burns

- Computer workstations major fuel source
- Combustibles – at least 200 kg per 2.4 m × 2.4 m unit
- 778 workstations on 5 floors most affected (94 –98)
- Input for Fire Dynamics Model

Test design

- 4 tests of workstation/loading similar to WTC-1
- 2 tests with jet fuel added, 2 with inert tile added
- 2 MW line burner source to represent fire spread between cubicles
- 2.7 m ceiling with 0.6 m lip to simulate radiant feedback
- 1 test with same workstation as found in WTC-1

Full Involvement of Fire near Peak Heat Release Rate



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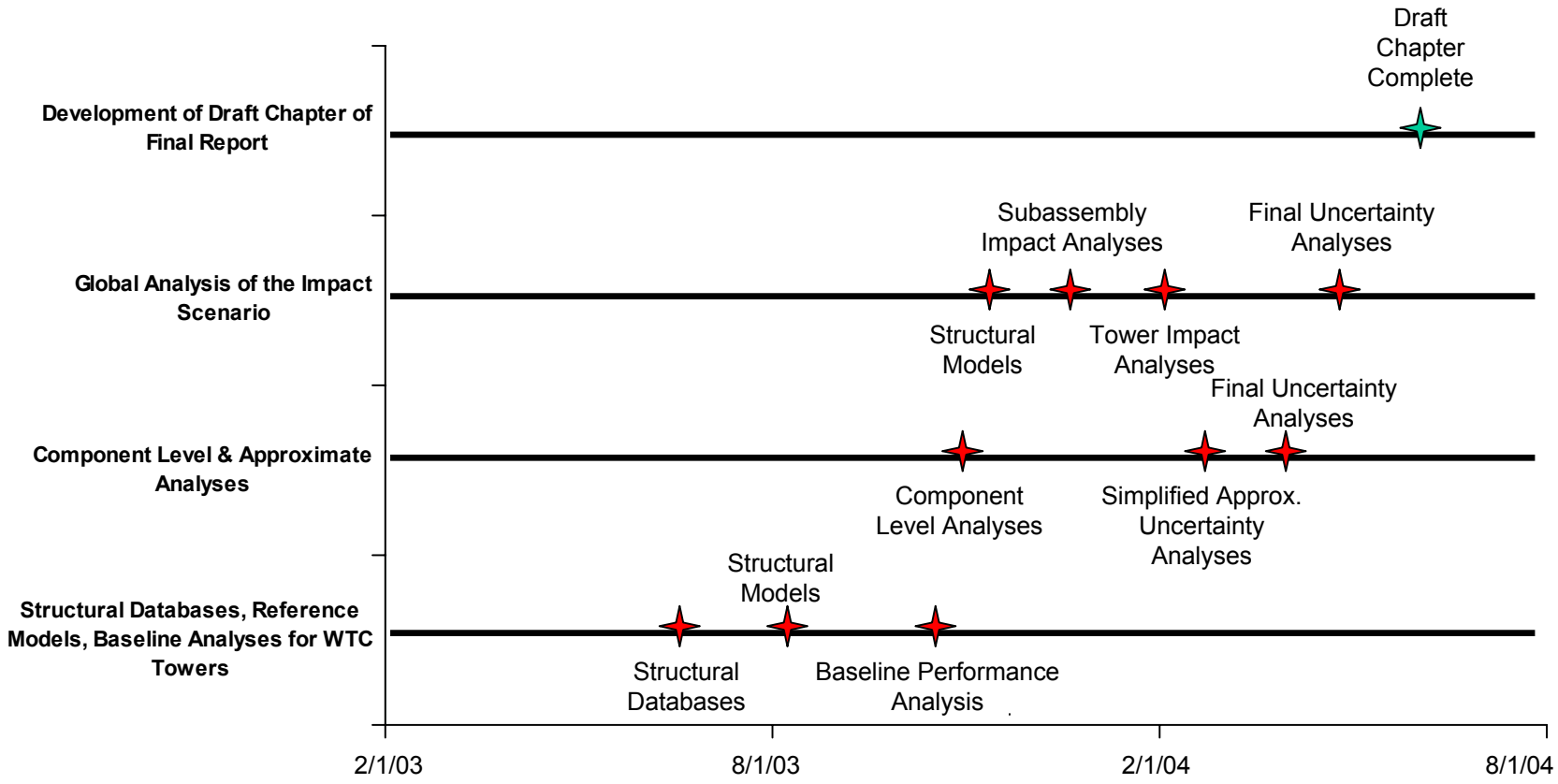
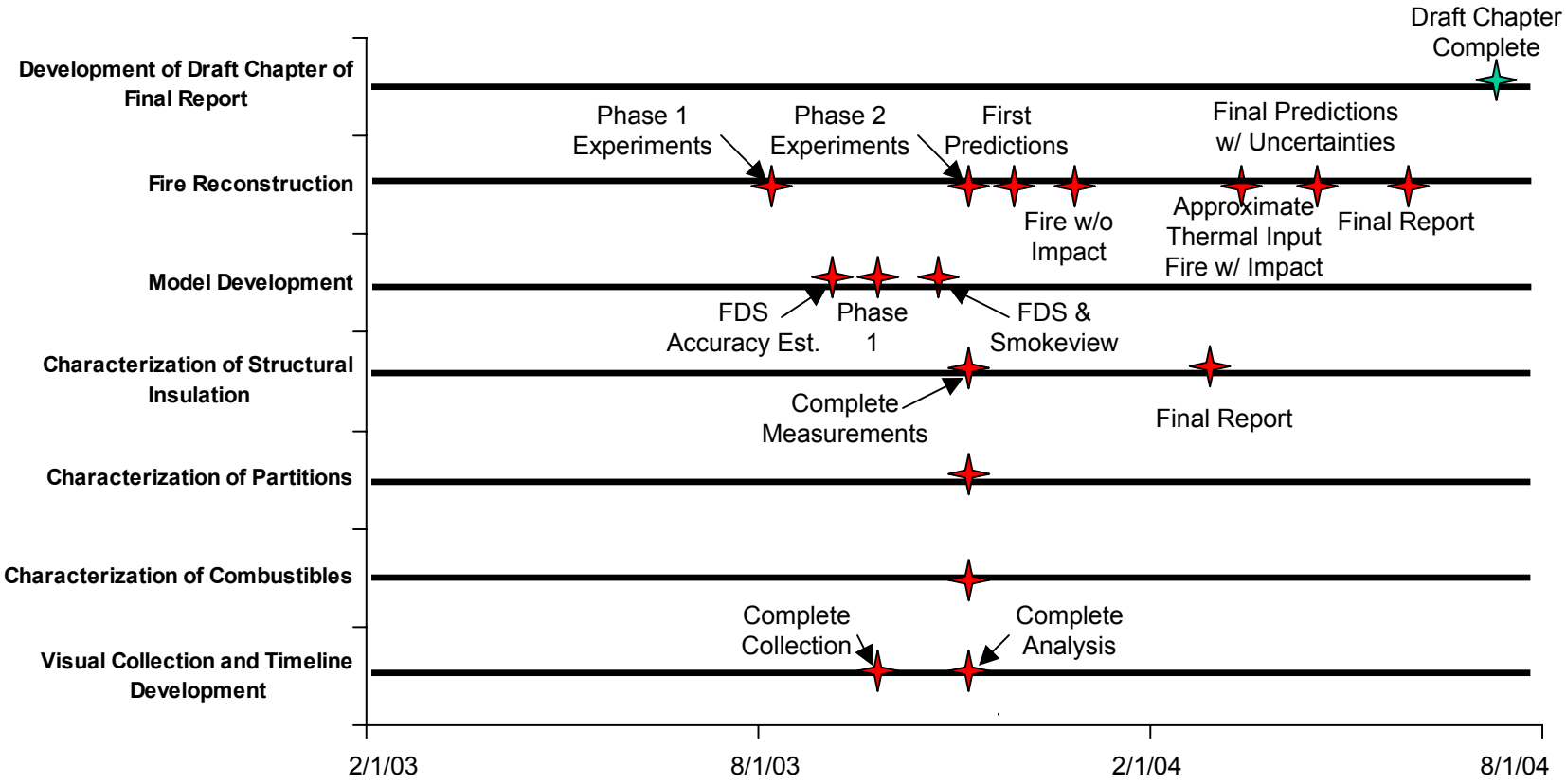
Project 2 – Baseline Structural Performance & Aircraft Impact Damage Analysis (Fahim Sadek)



Contractors: LERA, TBD (Aircraft Impact Analysis)

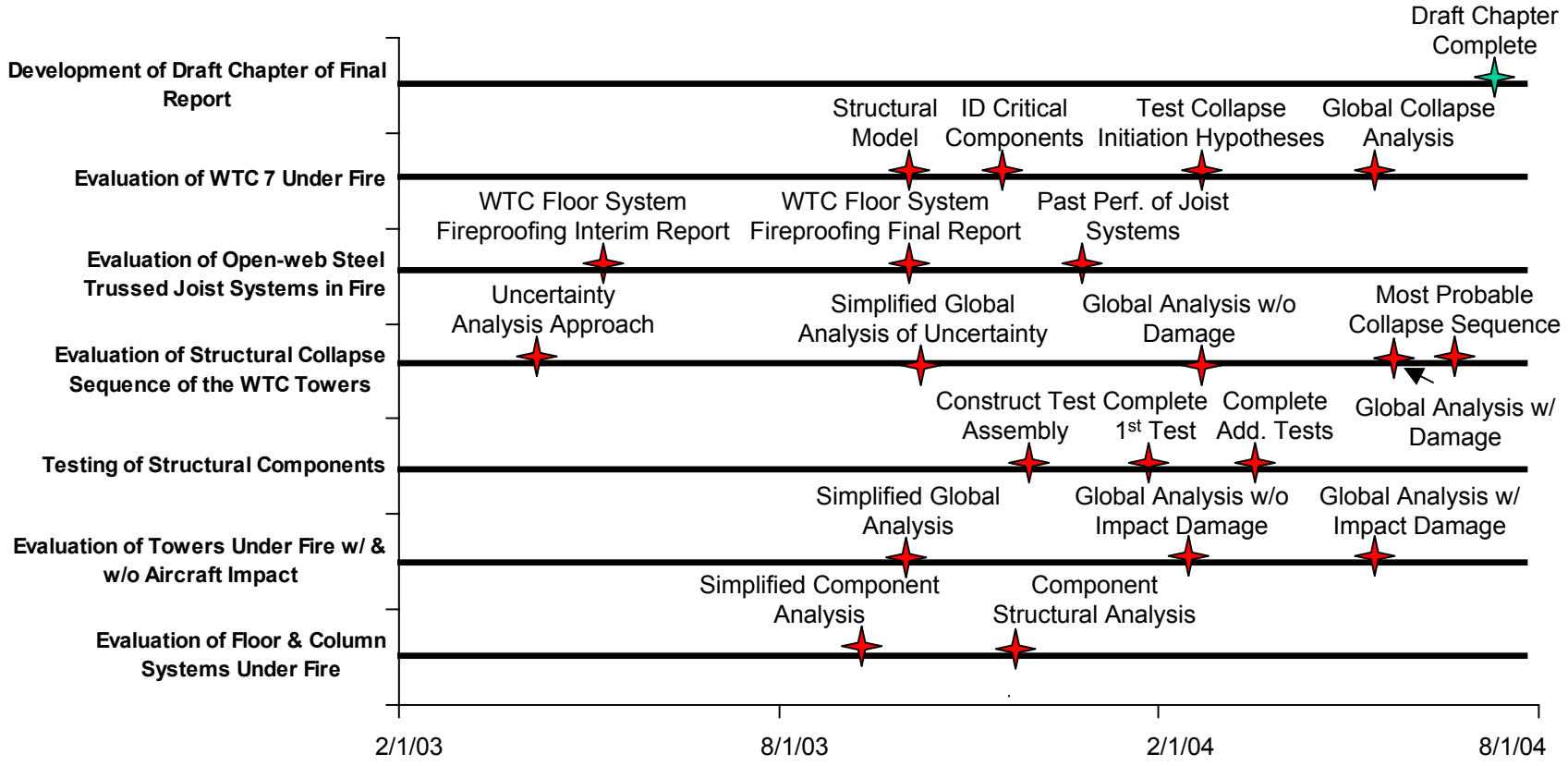
Outside Experts: SOM, D. Parks, Teng & Assoc., D. Veneziano

Project 5 – Reconstruction of Thermal and Tenability Environment (Dick Gann)



Outside Experts: H. Nelson, V. Junker

Project 6 – Structural Fire Response & Collapse Analysis (John Gross & Terri McAllister)



Contractors: TBD (WTC 7), TBD (WTC Towers), UL (E119 Testing), TBD (Open-web Joists)

Outside Experts: D. Veneziano, J. Van Dyck, K. Willam, Teng & Assoc.

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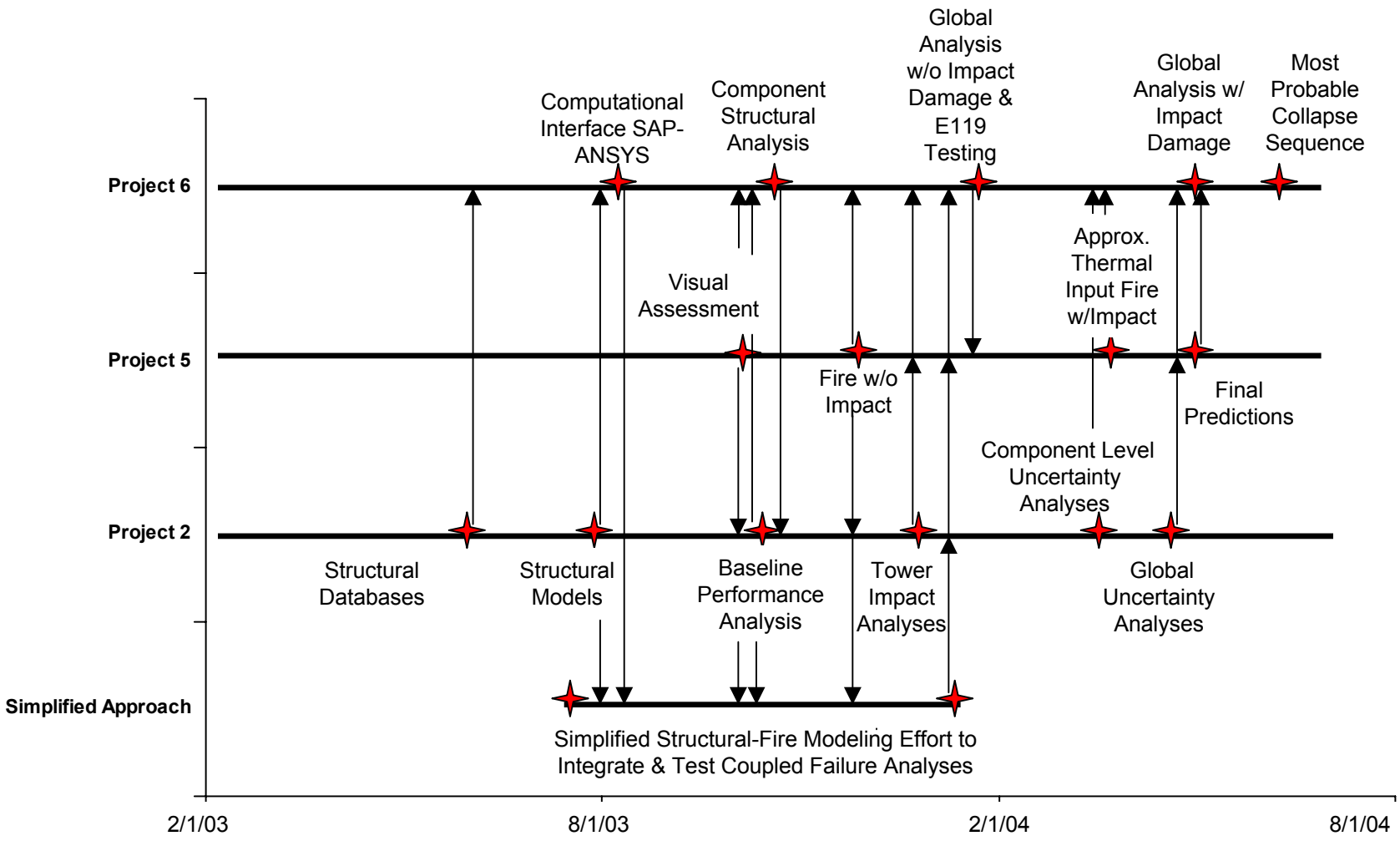
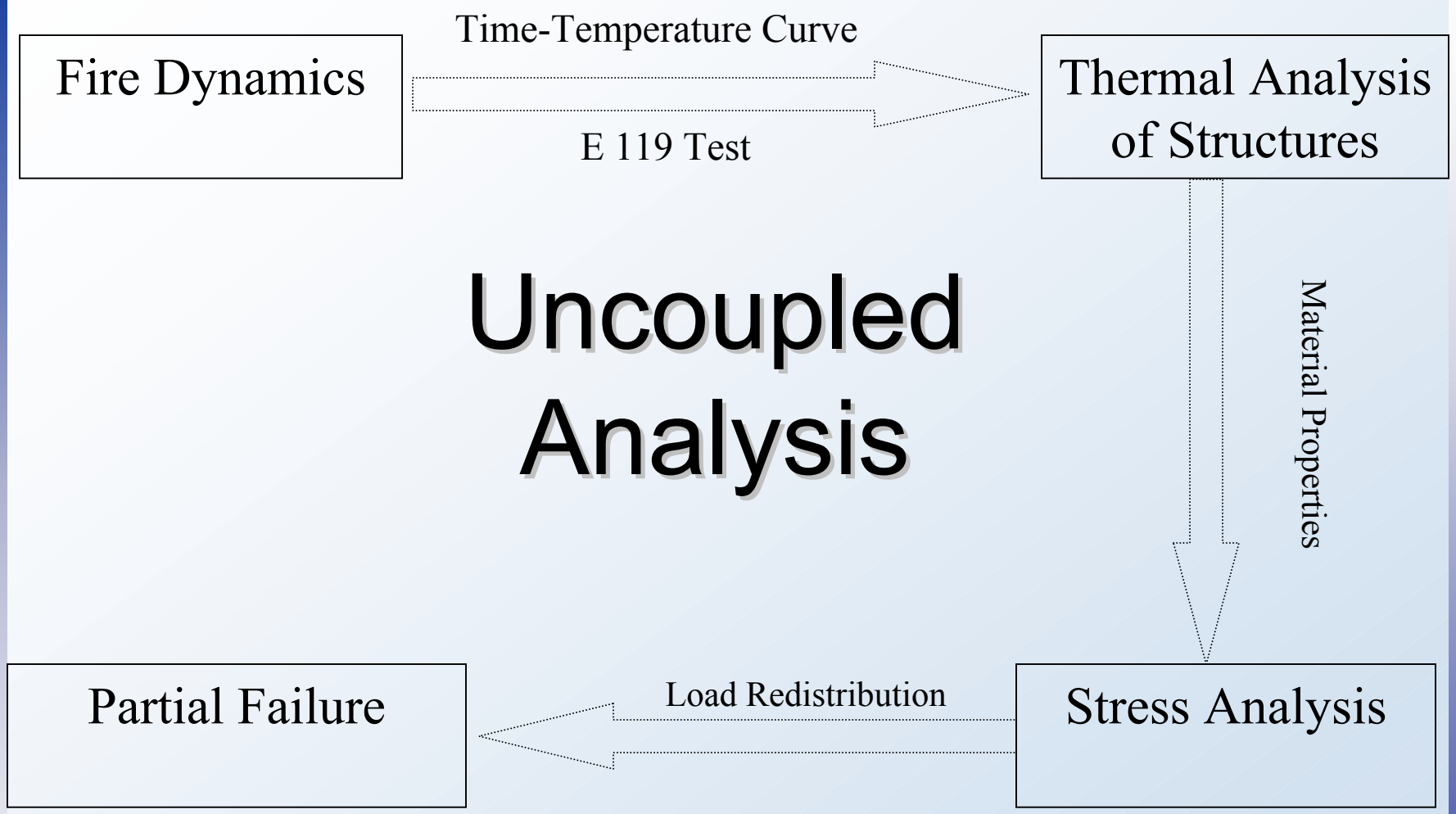
Projects 2, 5 & 6 Interfaces





Uncoupled Analysis

Current Method:

Deterministic, Linear and Sequential Analysis
of Collapse Induced by Fire-Structure Interaction

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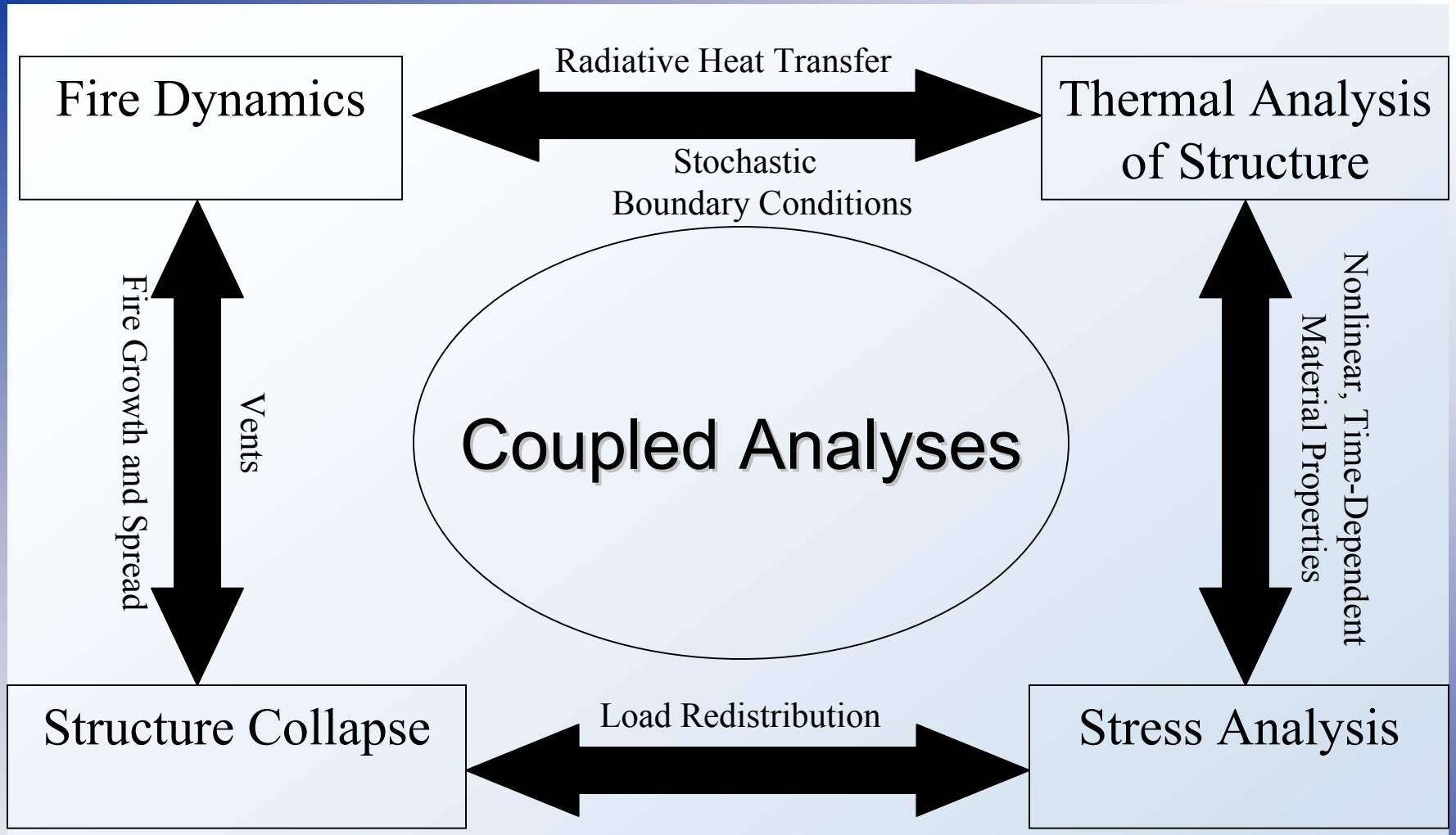

Proposed Method:

Probabilistic, Nonlinear, Coupled Analysis of Collapse Induced by Fire-Structure Interaction

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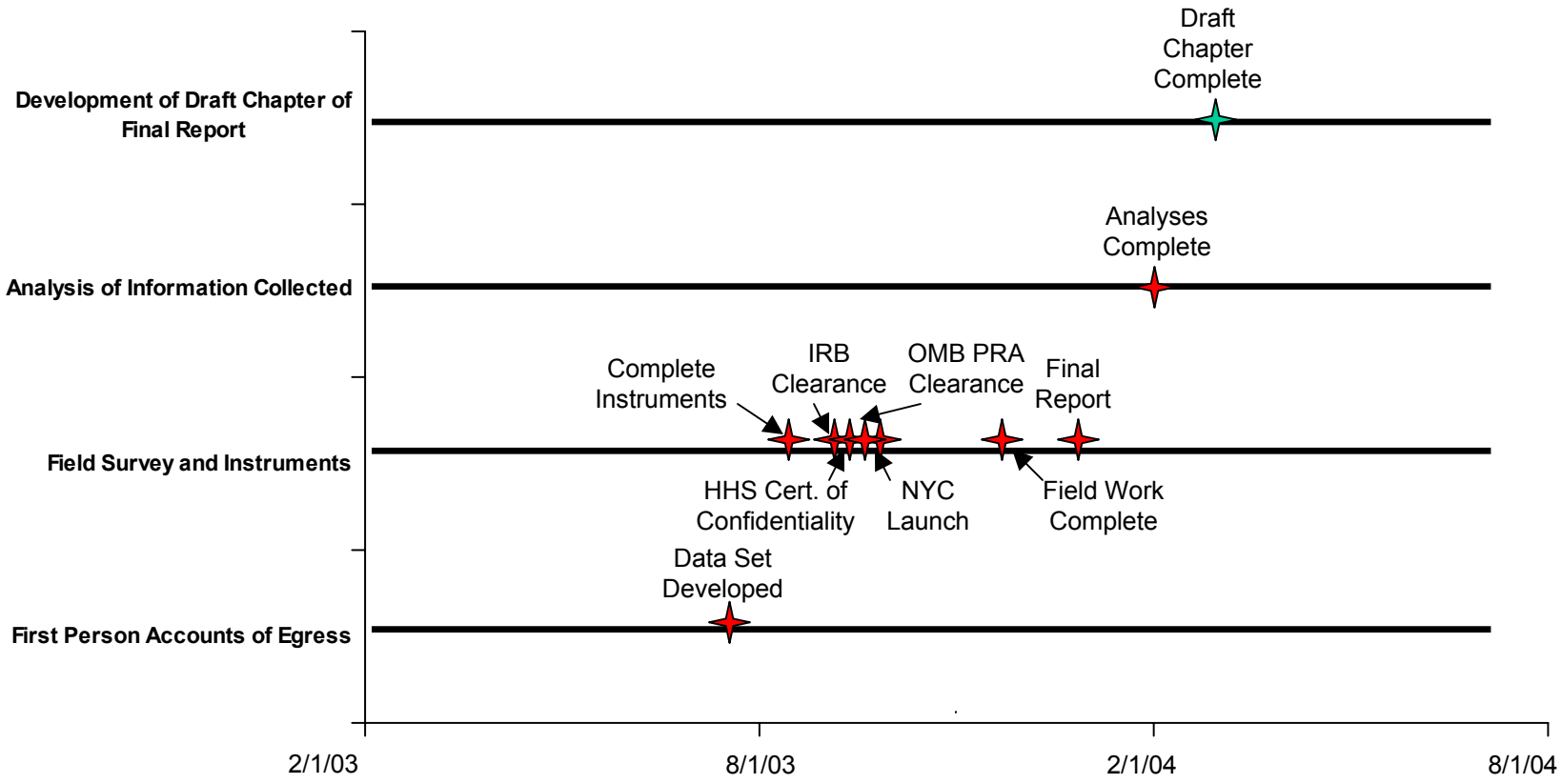
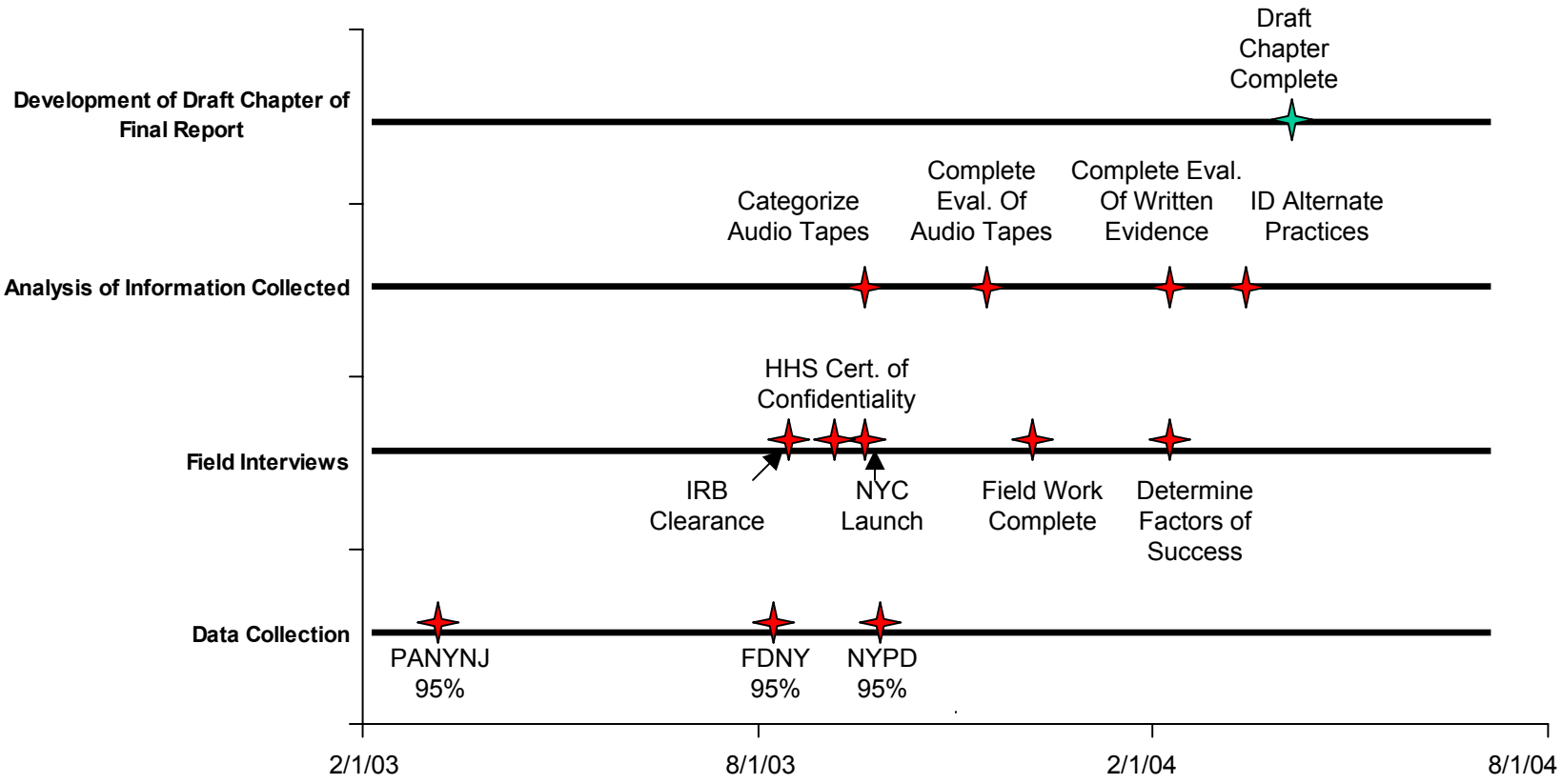
Project 7 – Occupant Behavior, Egress, & Emergency Communications (Jason Averill)



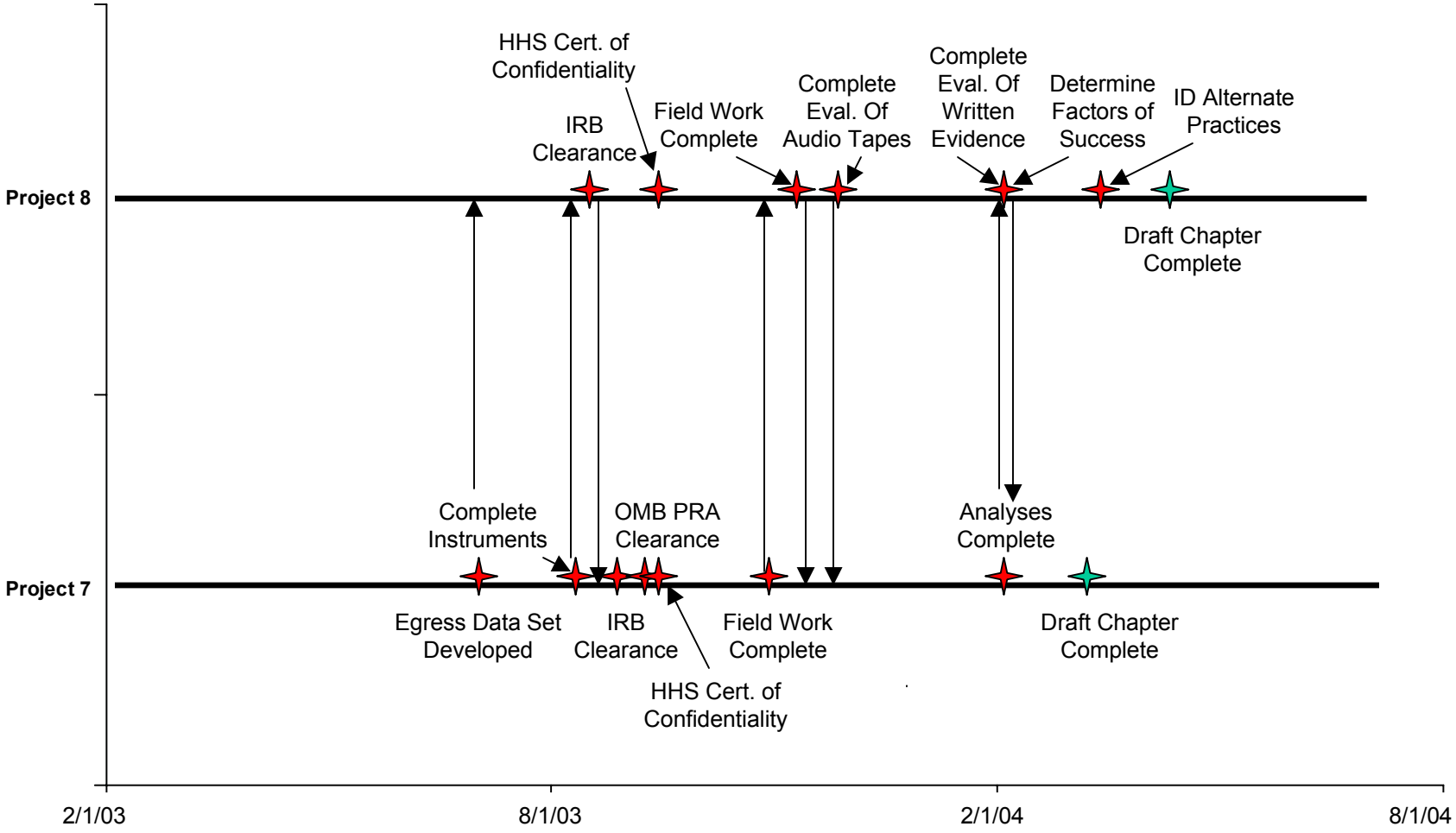
Contractors: NuStats including DataSource, GeoStats, MBC Res. Ctr. , NFPA
Outside Experts: D. Mileti, G. Proulx, N. Groner, H. Nelson

Project 8 – Fire Service Technologies & Guidelines (Randy Lawson)

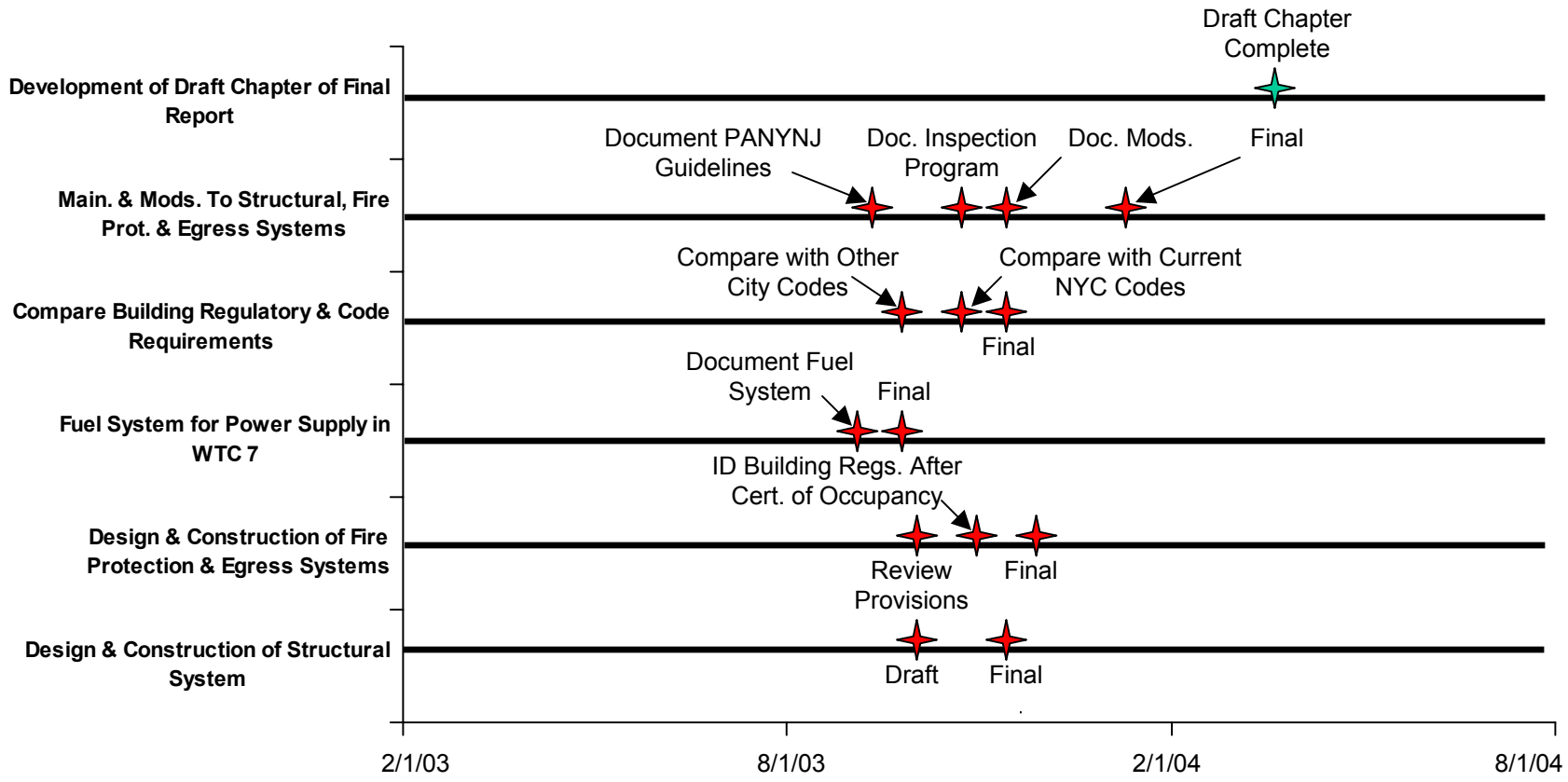


Outside Experts: V. Dunn, K. Malley, J. Hodgens

Projects 7 & 8 Interfaces

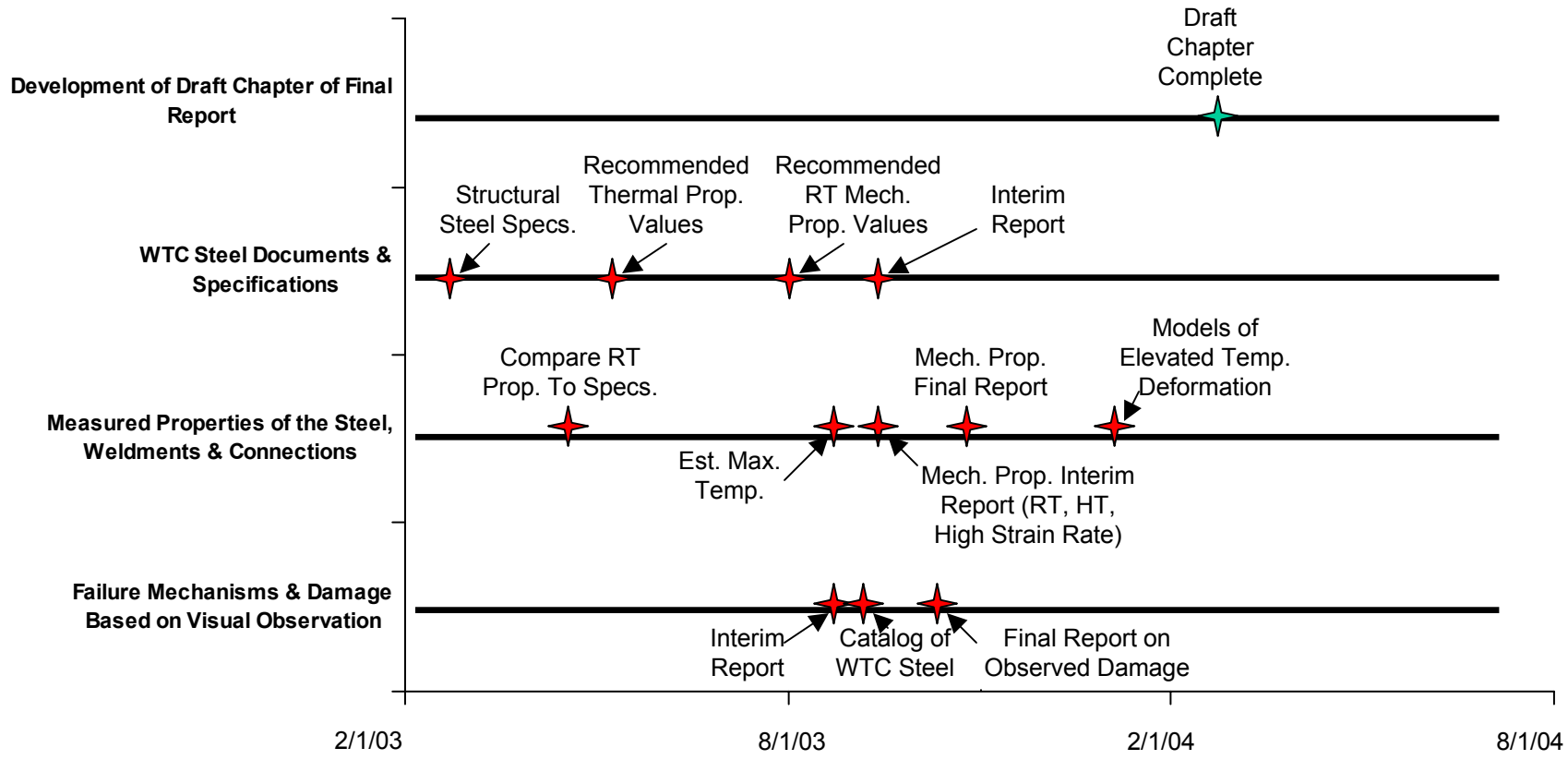


Project 1 – Analysis of Building & Fire Codes And Practices (H.S. Lew & R. Bukowski)



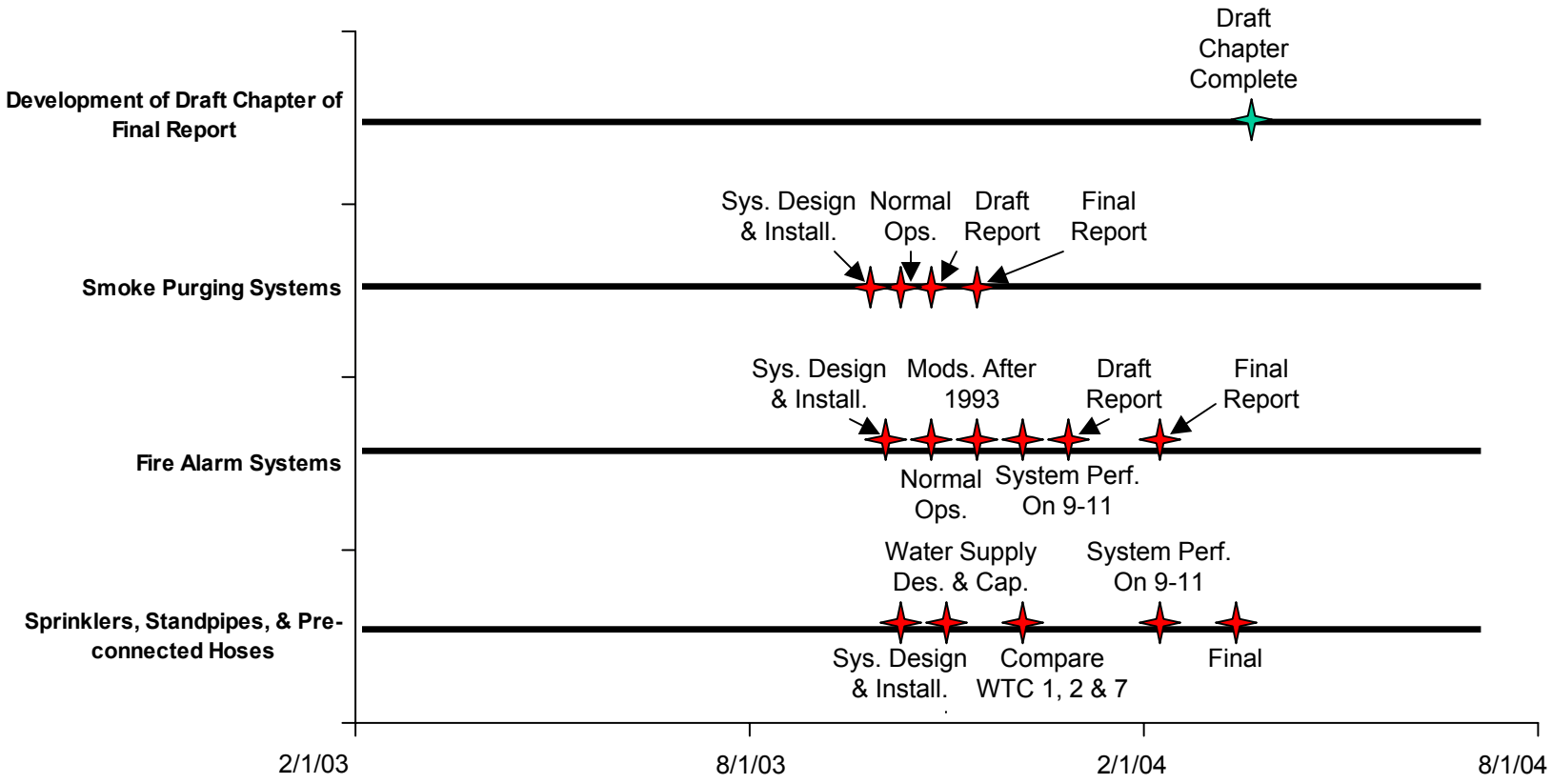
Contractor: Rolf Jensen & Associates including S.K. Ghosh Associates, Inc. & Rosenwasser/Grossman Consulting Engineers

Project 3 – Mechanical & Metallurgical Analysis of Structural Steel (Frank Gayle)



Contractor: Wiss, Janney, Elstner Associates, Inc.

Project 4 – Investigation of Active Fire Protection Systems (Dave Evans)



Contractors: TBD (Active Fire Prot. Sys.), TBD (Fire Alarm Sys.), TBD (Smoke Purging Sys.)

6. Advisory Committee Feedback

- Feedback on individual WTC investigation projects; coupling of Projects 2, 5, and 6
- Suggestions for content of December 2003 progress report
- Possible scope and content of session at December 2003 meeting

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