Research on Objective Tests for Integrated Safety

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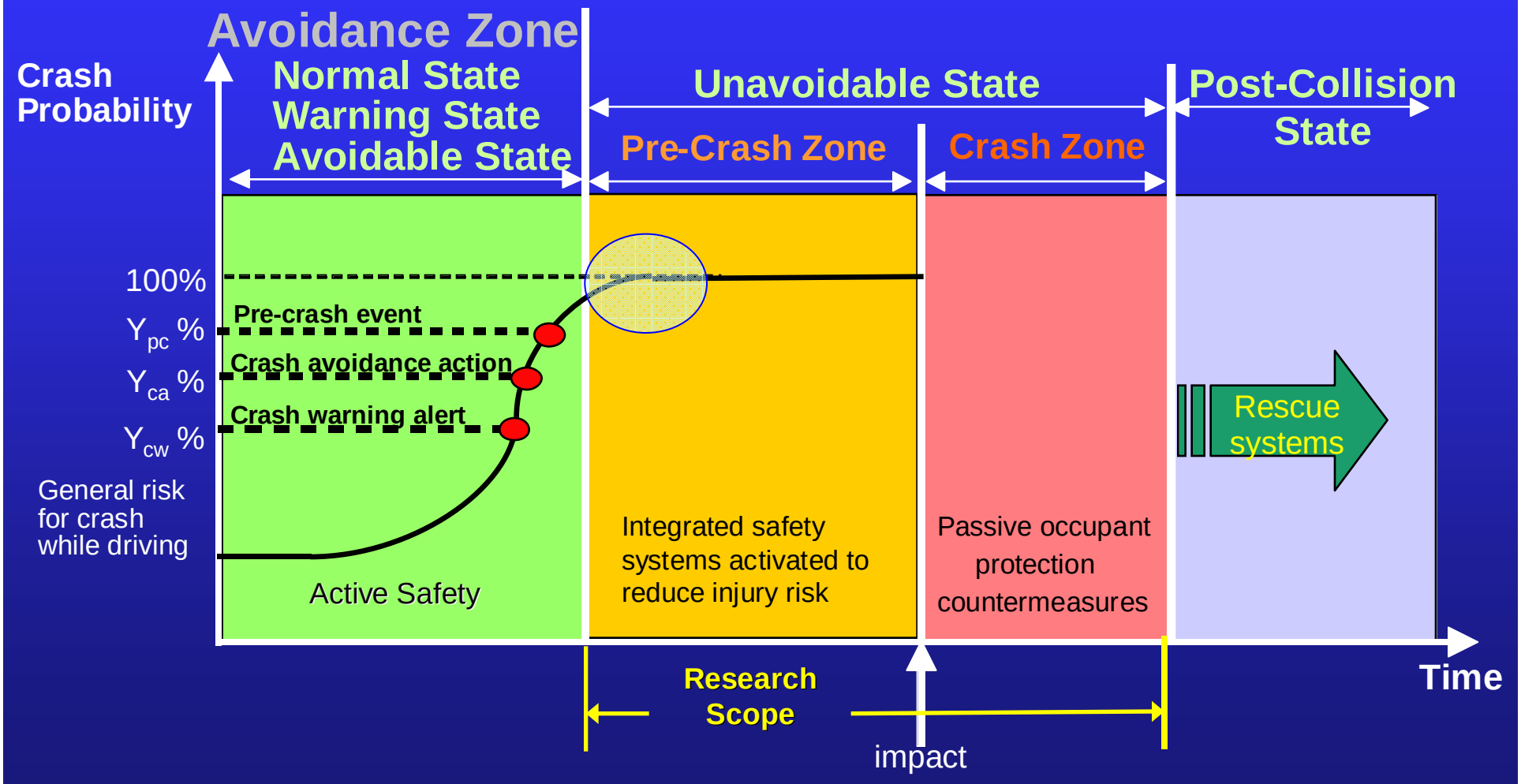
Research Scope

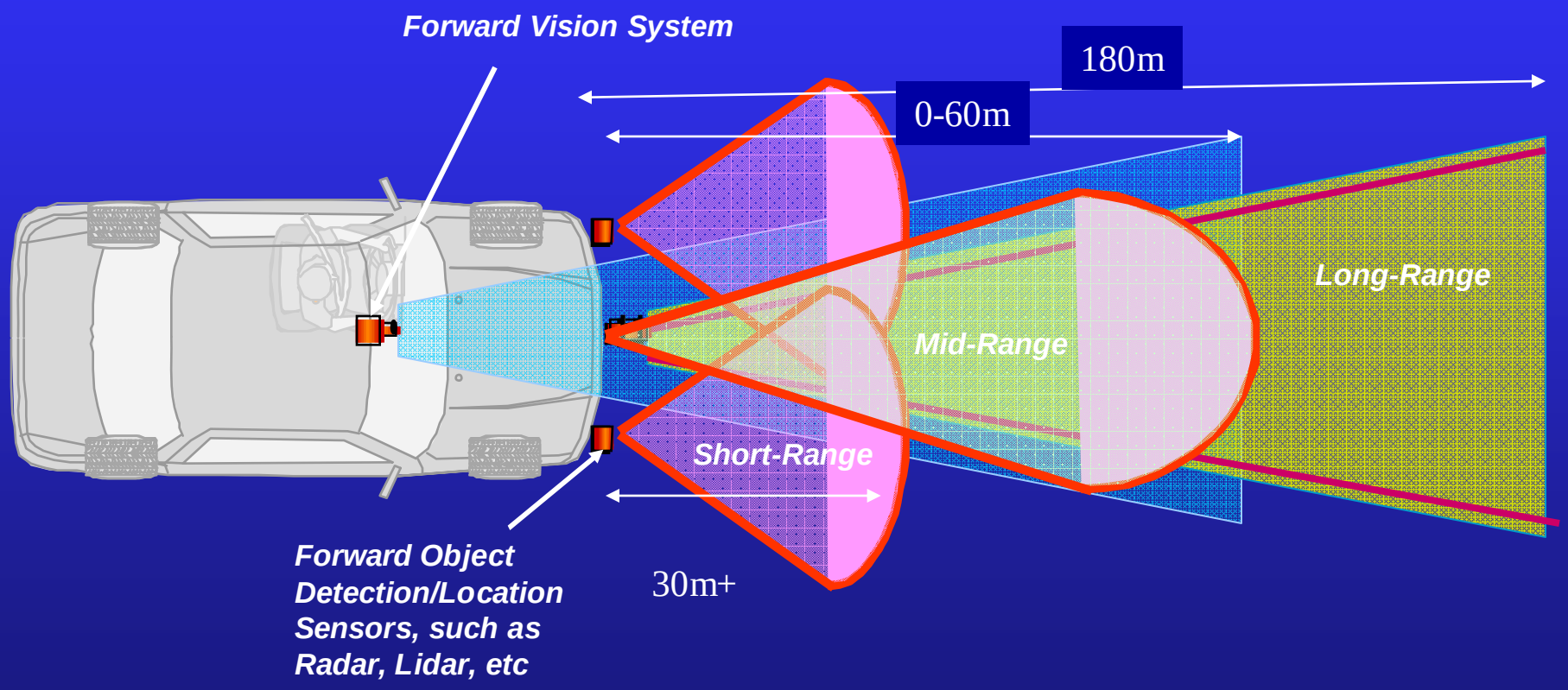
- Pre-competitive research in integrated safety crashworthiness
- Using pre-crash sensors for injury mitigation

- Autonomous safety systems
- Imminent crash conditions
- Crash types that cause severe injuries
- Near term deployable countermeasures
- Estimate reduction in injury and harm

Critical Event Timeline



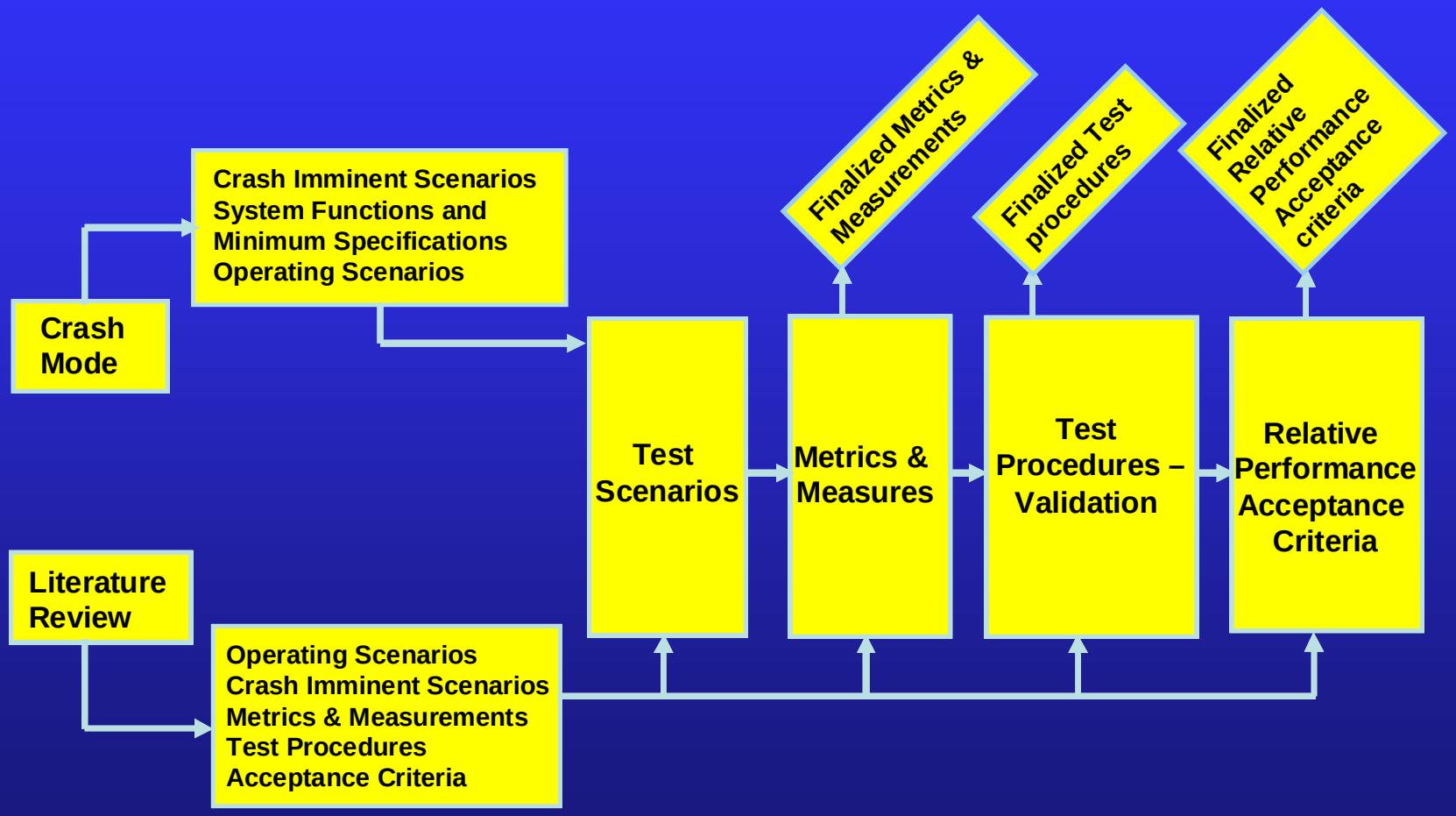
Example Pre-Crash Sensor Suite



Research Objectives

- Implement cooperative research with the industry
- Develop and validate minimum performance requirements and objective test procedures for crash imminent systems
- Identify and fabricate the most promising prototype candidate countermeasures to support test method development
- Support preliminary estimates of predicted benefits from prototype systems
  - -Volpe to lead on crash data analysis and preliminary benefits estimates
  - -VRTC to provide independent test and evaluation

Objective Test Development Process



Project Task List

TASK 1: PROJECT MANAGEMENT

TASK 2: TARGET CRASH SCENARIOS AND DEVELOPMENT OF PRELIMINARY FUNCTIONAL REQUIREMENTS

- Crash field database analyses, GES, CDS, CIREN, SCI
- Identification of predominant crash types for maximum harm reduction/benefits from crash database(s)
- Establish performance metrics for injury/harm reduction
- Develop preliminary functional requirements for countermeasures based on performance metrics

  (Milestone)

Example Top Level Crash Data

No.	Pre-Crash Scenario (2004 GES Data*)	Main Crash Types	Functional Years Lost	Annual Frequency
1	Control Loss without Prior Vehicle Action (ESC?)	TBD	478,000	529,000
2	Road Edge Departure without Prior Vehicle Maneuver	F-obstacle	270,000	334,000
3	Lead Vehicle Stopped	F-R	240,000	975,000
4	Vehicle(s) Not Making a Maneuver - Opposite Direction	F-F	206,000	124,000
5	Straight Crossing Paths at Non-Signalized Intersections (side bags?)	F-S	174,000	264,000
6	Pedestrian Crash without Prior Vehicle Maneuver	F-ped	144,000	39,000
7	Vehicle(s) Turning at Non-signalized Junctions	F-F, F-S	138,000	435,000
8	Running Red Light	F-F, F-S	135,000	254,000
9	Left Turn Across Path - Opposite Direction - Signalized	F-F	121,000	220,000
10	Left Turn Across Path - Opposite Direction - Non-Signalized	F-F	113,000	190,000
11	Lead Vehicle Decelerating	F-R	100,000	428,000
12	Lead Moving at Constant Slower Speed	F-R	78,000	210,000
13	Vehicle(s) Changing Lanes - Same Direction of Travel	S-S	71,000	338,000
14	Control Loss with Prior Vehicle Action (ESC?)	TBD	49,000	103,000
15	Pedalcyclist Crash without Prior Vehicle Maneuver	F-cyc	39,000	24,000
	*Source: Najm, W. and D. Smith, "Definition of a Pre-Crash Scenario Typology for Vehicle Safety Research," Paper No. 07-0412, 20th ESV Conference, Lyon, France, June 2007.			

Project Task List (cont'd)

TASK 3: TECHNOLOGY SURVEY AND SYNTHESIS OF COUNTERMEASURE CONCEPT CANDIDATES

- Supplier technology sweep to select and synthesize available countermeasure concept candidate technologies:
  - Precrash exterior sensors and interior occupant sensors
  - Braking and advanced restraint technologies

TASK 4: DETERMINE THE INITIAL COMPONENT PERFORMANCE SPECIFICATIONS

- Set initial component specifications and formulate advanced safety systems
- Use of CAE modeling & analysis to form a matrix of advanced safety systems

TASK 5: PRELIMINARY EVALUATION AND RANKING OF SYSTEM CONCEPT CANDIDATES

- Establish criteria and weighting factors
- Use CAE analysis to rank system proposals
- Select prototype candidate safety systems for further development (Milestone)

Project Task List (cont'd)

TASK 6: DEVELOPMENT AND FABRICATION OF PROTOTYPE SYSTEMS SUITABLE FOR TESTING

- Design and fabricate selected Prototype Improvement Systems (PIPs) for testing

TASK 7: DEVELOPMENT OF OBJECTIVE TEST PLANS

- Develop objective test procedures and test plan
- Minimize number of tests and properties using CAE analysis

TASK 8: DEMONSTRATION AND VALIDATION OF THE OBJECTIVE TESTS

- Conduct sled and test track tests as per approved test plan
- Verify with full vehicle crash tests
- Collect test data and perform analysis of test results

Project Task List (cont'd)

TASK 9: FINALIZATION OF THE PERFORMANCE AND TEST SPECIFICATIONS

- Minimum performance specifications for the selected advanced safety systems
- Finalize objective test procedures and performance measures

TASK 10: FINALIZATION OF THE BENEFITS

- Define an agreed benefits estimation method for determining harm reduction
- Determine benefits and effectiveness of tested advanced safety system(s) using the agreed benefits estimation method

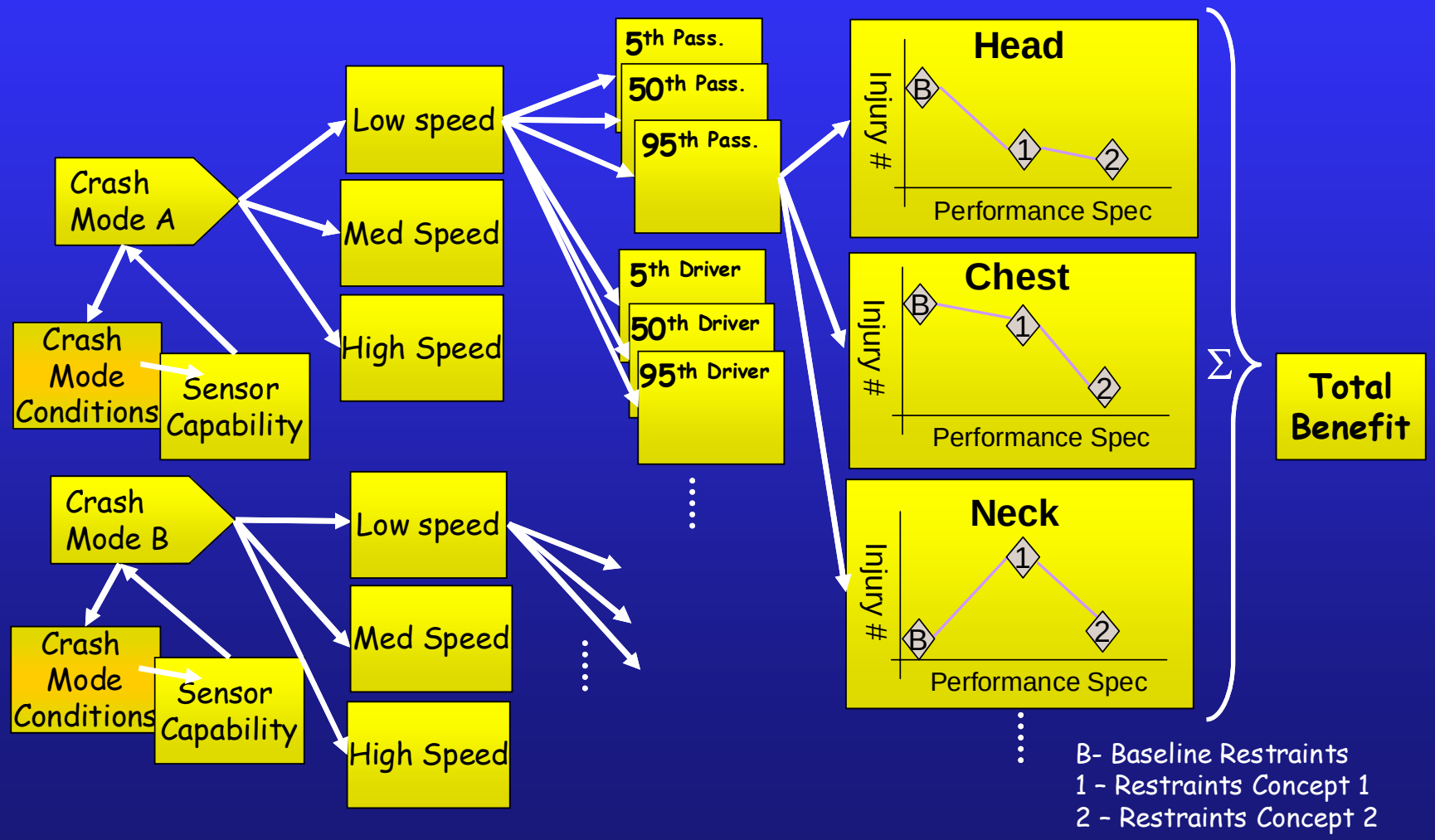
(Milestone)

TWO PROJECTS IMPLEMENTED

- Advanced Restraint Systems, ARS
  - Consortium – Ford, GM, Daimler, suppliers TBD
  - New technology investigated
    - Adaptive belts, smart restraints, integrated sensors
    - Environmental and occupant sensors
  - System adapts to the needs of the occupant and the crash

- Crash Imminent Braking, CIB
  - Consortium – Ford, GM, Delphi, Continental
  - New technology investigated
    - Full authority automatic braking with integrated sensors
    - Environmental sensors that add functions beyond car following
  - Include crashes were driver warning is not timely
    - For example, road departure obstacles, left turn at intersections, head on crashes.

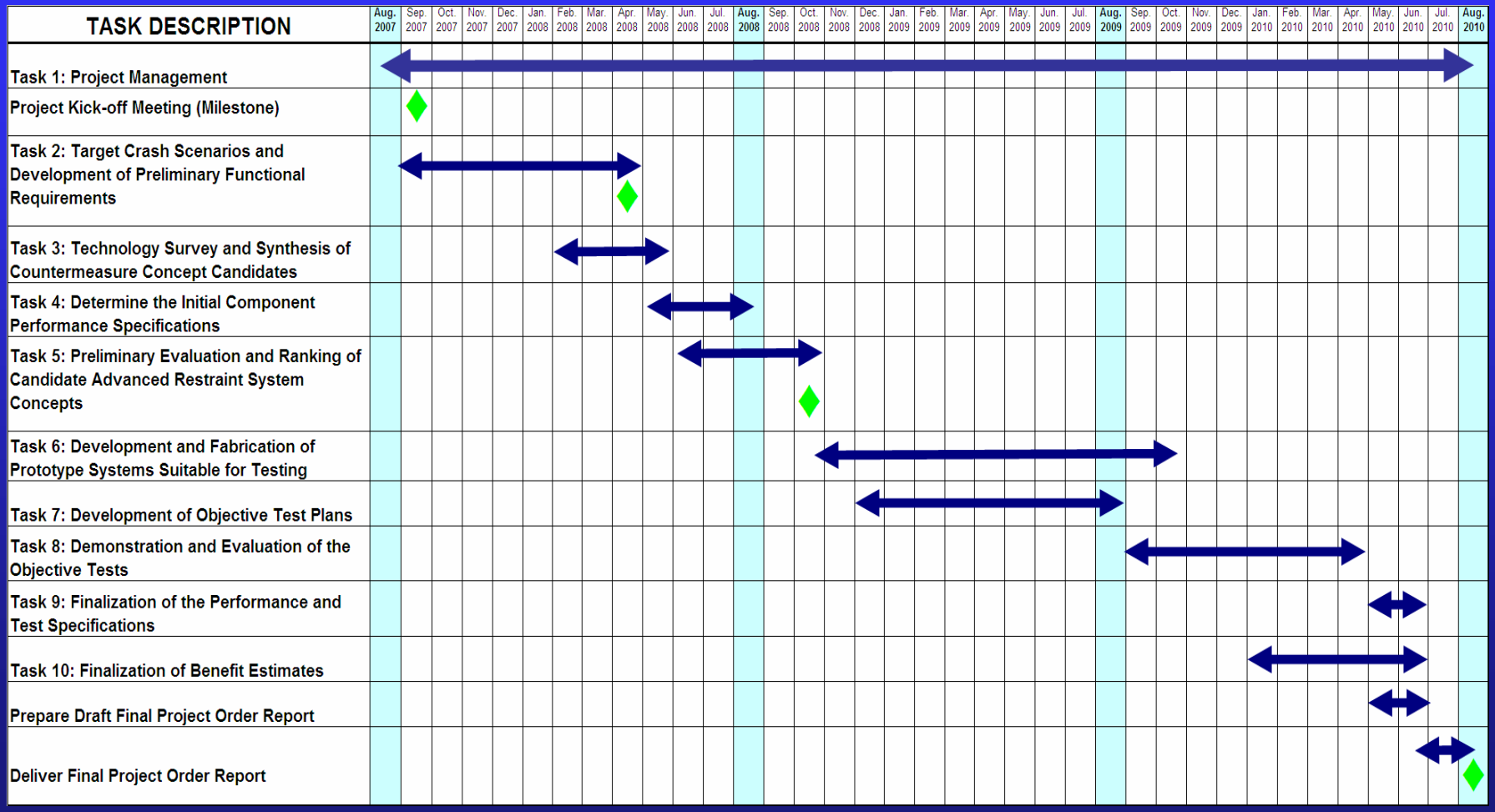
ARS Safety Benefit Analysis



B- Baseline Restraints
1 – Restraints Concept 1
2 – Restraints Concept 2

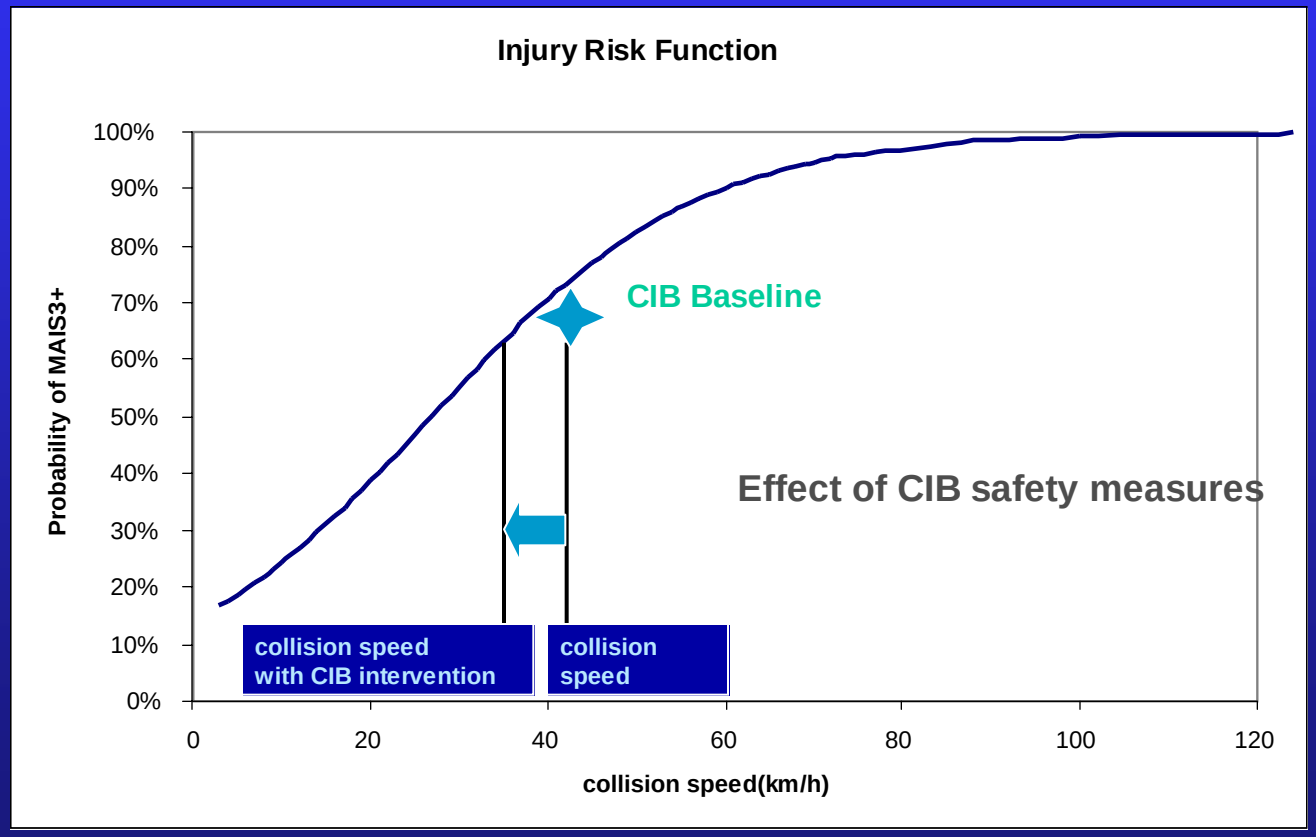
ARS SCHEDULE AND MILESTONES

Timeline: 36 months



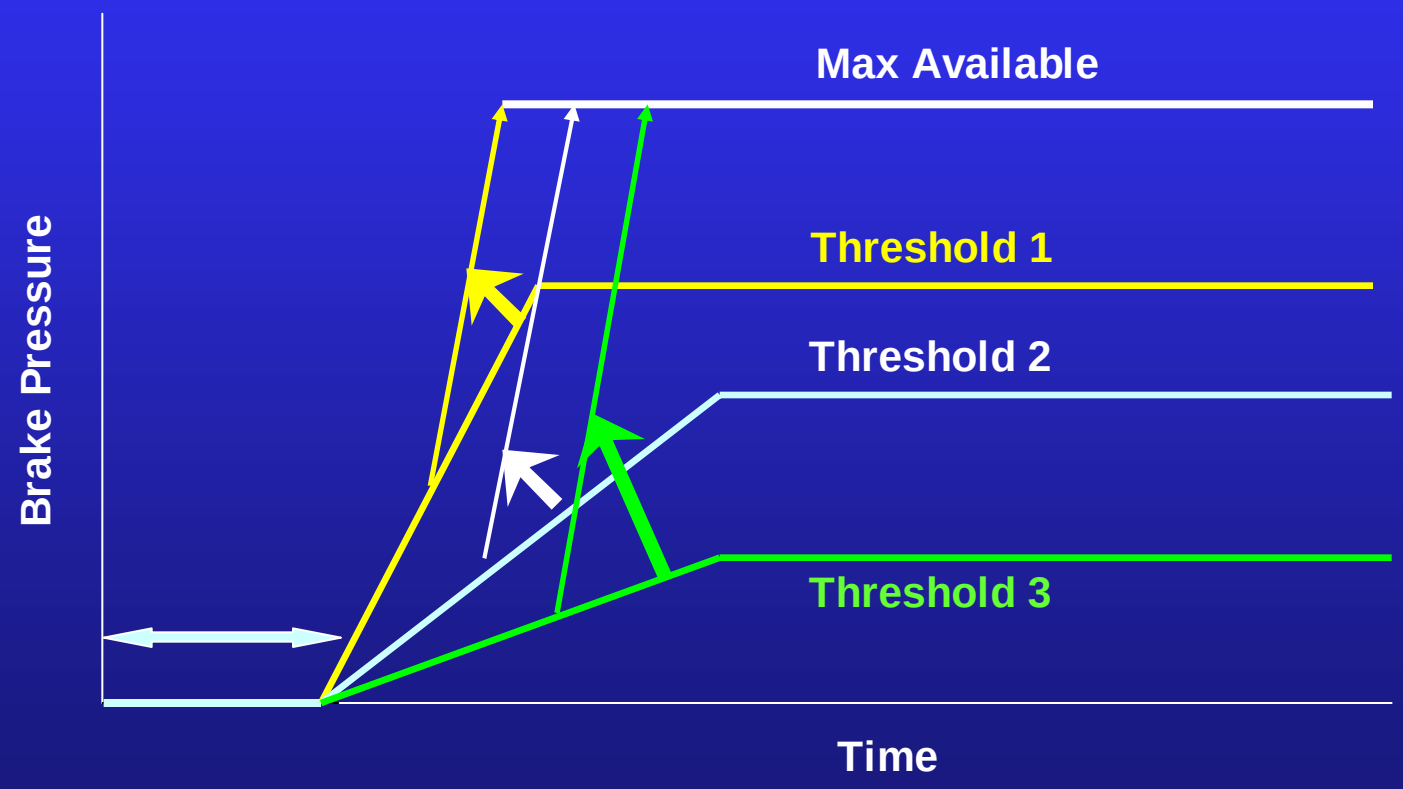
INFLUENCE OF CIB SYSTEMS

Expect reduced collision speed and resulting reduction on injury risk



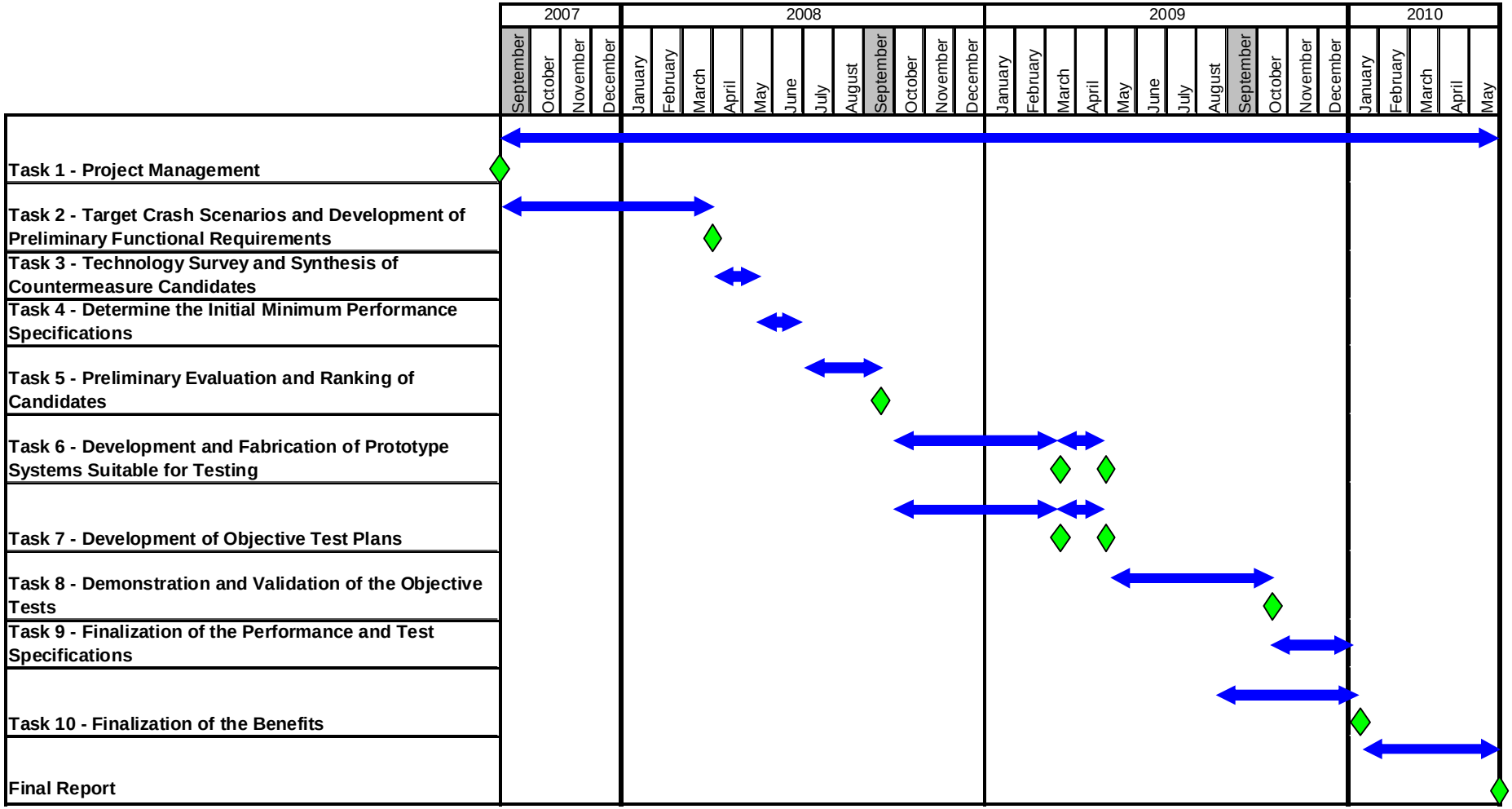
AUTOMATIC BRAKING CONCEPTS

Example Brake Actuator Adjustments



CIB Timing & Milestones

Timeline: 32 months



Thank You