ADVANCING DERAILMENT OIL SPILL LOSS AND MASS ESTIMATES

Mike Bethge and Mike Austin – CSX Transportation, Inc.
Fred Payne and Andy McManus – Arcadis

October 2015

HOW TOMORROW MOVES

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INCIDENT SYNOPSIS

- February 16, 2015
  Mt Carbon, WV
  Kanawha River Valley
- Air Temp 11°
  Winter Storm
- Unit train
  Bakken crude oil
  API 43+
  Flash point < 60° F
- 27 tank cars derailed
  20 with product loss

INCIDENT SYNOPSIS

- Oil from initial losses ignited, triggering a series of heat induced tears over a 10-hour period.

25 hours after derailment

MODES OF DAMAGE AND LOSS - OVERVIEW

- Damage and loss modes
  - Puncture
  - Bottom outlet valve failure
  - Pressure relief device
  - Manway failure
  - Heat induced tear
- Modes and locations of loss are the foundation for mass balance

MODES OF DAMAGE AND LOSS - PUNCTURE

- Key source for ground losses
- May create pools that can be ignited

- Loss rates can generate overland sheet flows

MODES OF DAMAGE AND LOSS – BOV LOSS

- Can be source of significant ground loss
- May create pools that can be ignited

MODES OF DAMAGE AND LOSS – PRD LOSS

- Significant mode of atmospheric burn
- May precede heat induced tear

MODES OF DAMAGE AND LOSS – MANWAY FAILURE

- Relatively slower loss rates
- May accelerate as seals and metal fail at extreme temperatures

MODES OF DAMAGE AND LOSS – HEAT INDUCED TEARS

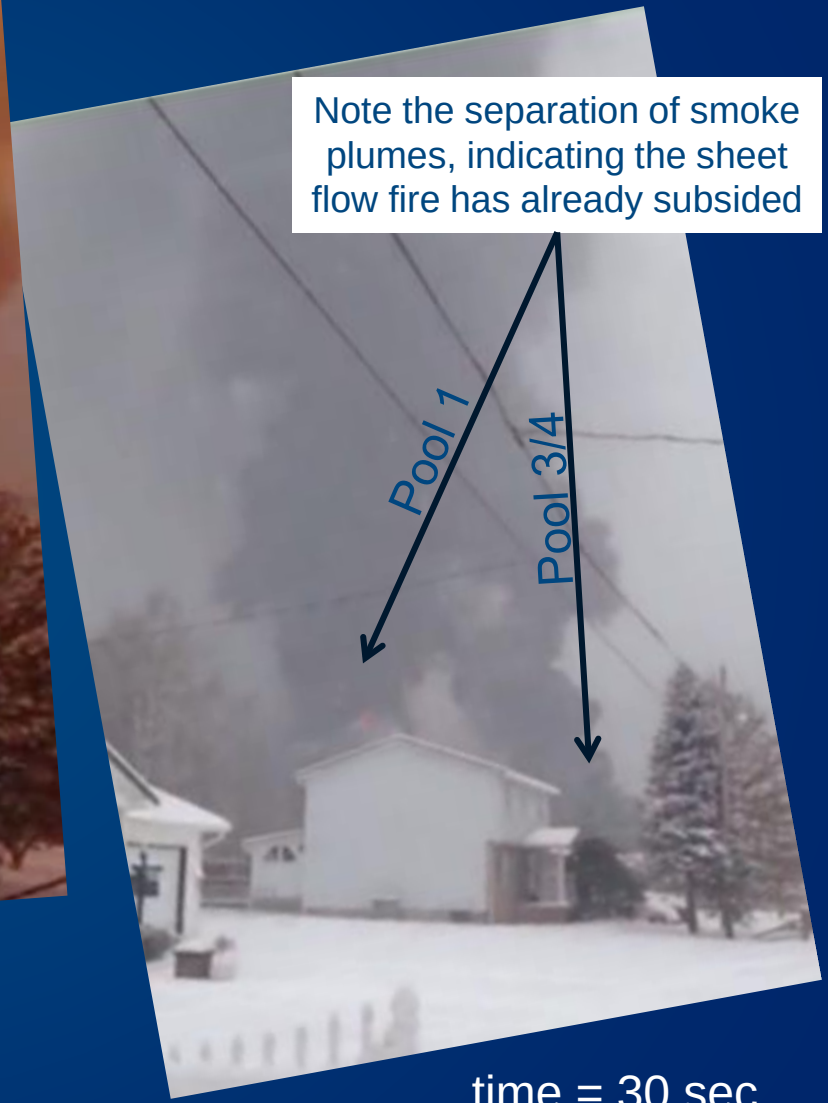
- Primary mode of atmospheric burn
- A large fraction of the contents burn in the atmosphere
- Extended burn may occur in the car

Heat Induced Tear
Local first-responder video

time = 0 sec

time = 5 sec

time = 15 sec

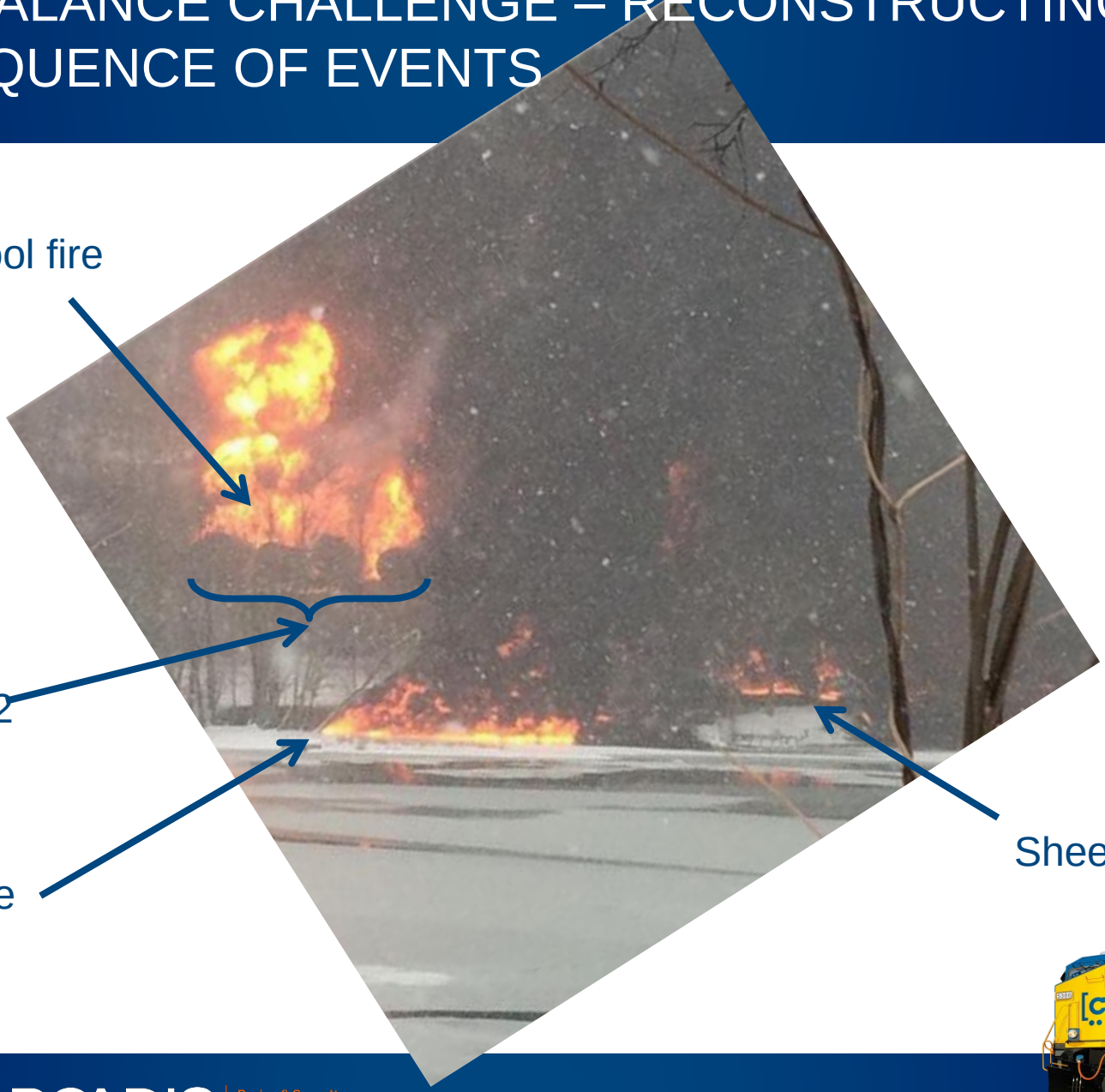


time = 30 sec

30-second time series showing fire resulting from a heat induced tear

MASS BALANCE STARTING POINT

MASS BALANCE CHALLENGE – RECONSTRUCTING THE SEQUENCE OF EVENTS



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Mt Carbon, WV
16 FEB 2015
Media Image 2

Track 2 ditch – Pool 1 fire

Sheet flow fires

Culvert outlet pool fire

Creek bank pool fire

River bank pool fire

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K080-14
Mt Carbon, WV
16 FEB 2015
Media Image 5

Trackside pool fire continues before 17:30 (pre-sunset)

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Mt Carbon, WV
16 FEB 2015
Media Image 6

Trackside pool fire continues after 17:30 (post-sunset)

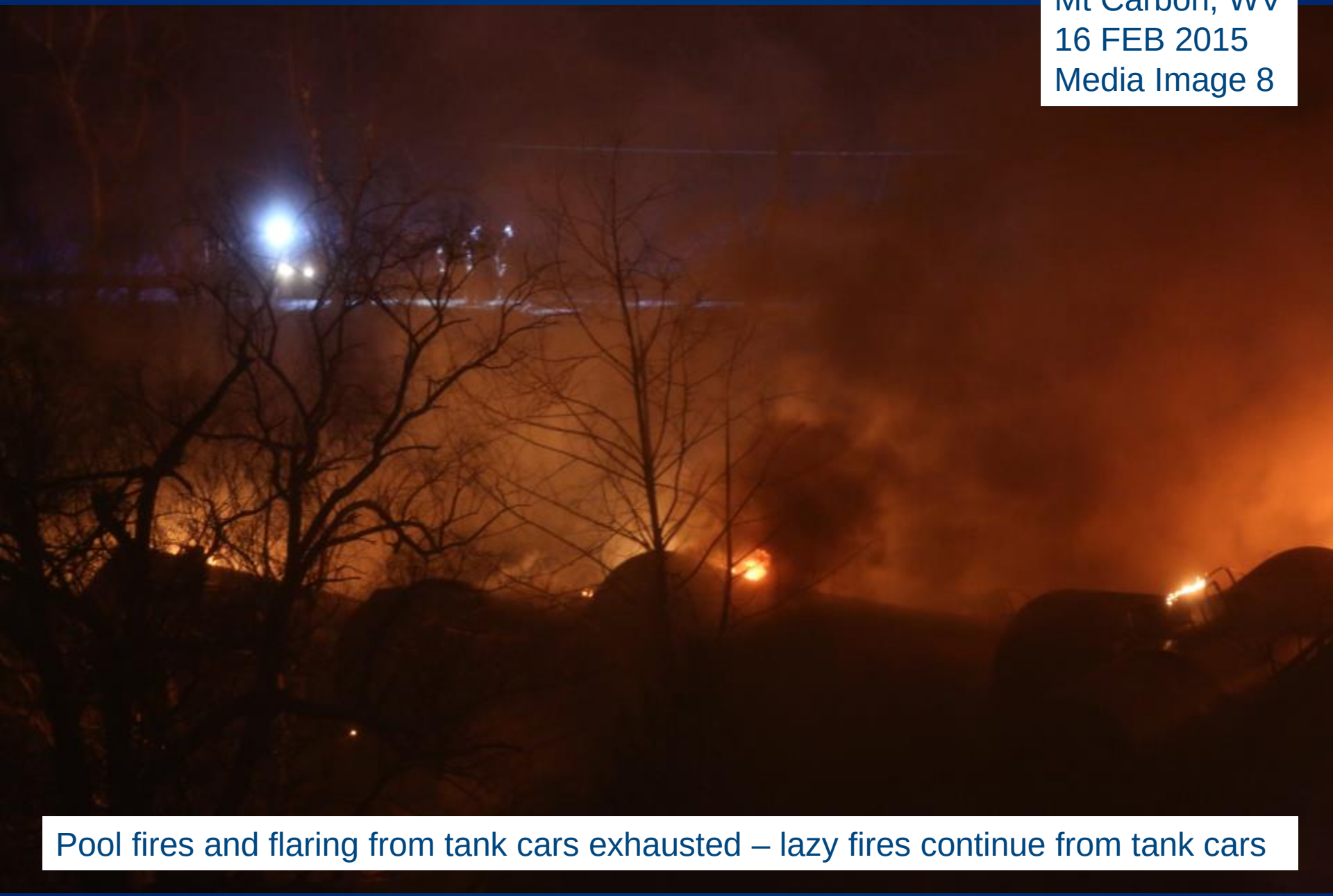
Mt Carbon, WV
16 FEB 2015
Media Image 7

Pool fires exhausted; in-car burning continues

Mt Carbon, WV
16 FEB 2015
CSXT image @ 20:25

Pool fires exhausted – flaring continues from tank cars

Mt Carbon, WV
16 FEB 2015
Media Image 8



Pool fires and flaring from tank cars exhausted – lazy fires continue from tank cars

ELEMENTS OF MASS BALANCE

- Quantify damage and losses car-by-car
  - Transfer tallies for each car, including final decon
  - Mode of loss contributes to the mass balance process
- Estimate amounts burned
  - Atmospheric and in-car
  - Pool fires
  - Sheet flow fires
- Quantify mass recovered from sorbents and surface removals
  - Sorbents
  - Direct removal to vac trucks
- Estimate mass in soils
  - Initial estimate by soil boring (LIF or direct sampling)
  - Estimate updated by quantification during removal

AREAS FOR ADDITIONAL REFINEMENT – THINGS WE'D LIKE TO KNOW

- Burn rates under various field conditions
  - Ambient temperature effects
  - Burn rates in ballast
  - Sheet flow
  - Pool size effects
- PRD loss rates
  - Venting head space
  - In liquid phase

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