Braking Systems & Distributed Power

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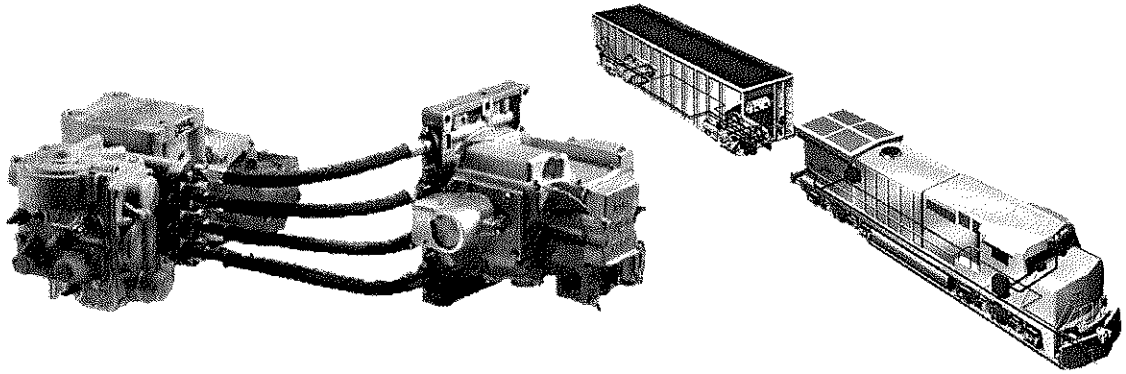
ECP brake systems are expensive and do not offer material safety advantages

- Electronically Controlled Pneumatic Braking (ECP) technology is expensive and only works if the entire train is equipped
  - *Data in UMLER shows < 1500 ECP equipped cars*
  - *Expected industry cost to upgrade to ECP: $12 - $21B*
    - *8-15K per car, 25-50K per locomotive*
- ECP brakes have limited use and minimal safety impact
  - *The majority of mainline braking is done via dynamic brakes which are unaffected by ECP technology*
  - *Information available on Crude Oil Train incidents indicate that the use of ECP or DP would have had no impact on preventing the incidents*

ECP system has limited advantages in an emergency situation



ECP system electronically sends a signal to each car, causing all cars to brake at the same time

- Once the brake signal is received by all cars, there is no difference in the stopping force of a traditional air brake system vs. an ECP brake system
  - *ECP braking relies on traditional air brake functionality to set the brake shoe against the wheel*
- If train is separated on an ECP system, an emergency brake application is initiated as in the case of a conventional braking system.
  - *This outcome is likely in a derailment situations*

ECP vs Conventional Braking Systems

	ECP	Traditional Application
Braking Technology	■ Electronically transmits signal to cars to brake	■ Propagates air through train
Time to Brake	■ All rail car brakes react simultaneously	■ Estimated 6-7 seconds per 100 car train
Effectiveness in Accident	■ If train separates, reverts to an emergency application of the brakes	■ If train separates, results in an emergency application of the brakes
Requirements	■ All cars and locos must be equipped with ECP brakes	■ No additional requirements
Industry Adoption	■ Low, only 15 estimated trains	■ Industry currently uses traditional air brake system
Cost	■ Total estimated industry cost (US): $12- $21B, plus additional maintenance and training	■ No additional cost

Distributed Power

- DP system places additional locomotives at intermediate points in the middle or end of a train
  - *System is remotely controlled from the leading locomotive*
  - Enables longer trains where operational considerations require DP or economics justify costs
  - *Assists trains in traversing difficult grades and curves*

Distributed Power has insignificant advantages in an emergency situation

- Distributed Power (DP) has efficiency advantages in specific lanes; industry uses DP today in those lanes

- Simulations on a 102 car train operating in DP vs. conventional brakes in an emergency brake application indicate:
  - Stopping times varied less than 2 seconds
  - Stopping distances varied less that 135 feet
  - No significant difference to in-train forces

Distributed Power has benefits in specific lanes

Pros

- Air reaches cars sooner due to distributed power throughout train
- Lower friction, potential fuel savings
- Increases ability to run heavier trains
- Ideal for coal/heavy unit train service (industry currently uses DP for many of these trains)

Cons

- Substantial capital investment ($70-80K/locomotive)
- Employees must be trained to use DP
- Increases time to build and switch trains
- Longer trains might require additional sidings or yard configurations
- Additional signal infrastructure is often required