Technical Memorandum #4 – Operations Assumptions and Service Modeling Framework

Introduction

This Technical Memorandum documents the operating assumptions and service modeling framework used to develop high-speed rail schedules for the Illinois High-Speed Rail Feasibility Study. The operations analysis establishes consistent methodologies for calculating travel times, service frequency, and system performance across all route options.

The operating assumptions reflect a combination of:

- High-speed rail operational best practices
- Simulation-based runtime modeling
- Corridor-specific infrastructure configurations

Together, these elements support development of realistic service plans suitable for feasibility-level evaluation of ridership, financial performance, and capital investment tradeoffs.

Operating Modeling Framework

Train performance and schedule development were conducted using Rail Traffic Controller (RTC) software by Berkeley Simulation Software, incorporating the Train Performance Calculator (TPC) to generate pure runtimes for high-speed rail operations.

Pure runtimes were developed using:

- Acceleration and deceleration characteristics representative of modern high-speed trainsets
- Maximum operating speeds of up to 220 mph where geometry permits
- Speed restrictions associated with horizontal curvature
- Scheduled station stops along each corridor

These pure runtimes represent the optimal speed profile under ideal operating conditions and form the baseline for developing proposed schedules used in the feasibility study.

Schedule Components

Final operating schedules incorporate multiple time elements necessary to reflect real-world railroad operations. These components include:

- Pure Runtime - the fastest achievable travel time between stations under ideal operating conditions, generated directly through RTC simulation.
- Schedule Pad - additional time applied as a percentage of pure runtime to account for operating variability, meets, and infrastructure constraints.
- Station Dwell Time - a standardized dwell time of two minutes per station, reflecting passenger boarding and alighting consistent with Amtrak intercity service experience

Operating Profile Assumptions

Key operating assumptions include:

- Operating window: approximately 4:30 AM to 10:30 PM
- Headways: hourly service in each direction
- Daily frequency: 32 trains per day (16 round trips)
- Operating separately from passenger and freight rail between University Park/Joliet and East St. Louis

Turnaround times at terminals were not explicitly modeled at this stage and will be refined in future phases based on crew procedures, cleaning cycles, and system initialization requirements.

Schedule Pad Methodology

Schedule padding is applied to pure runtime outputs generated through train performance simulation to convert idealized operating profiles into realistic schedules capable of accommodating day-to-day operational variability. While pure runtimes reflect optimal train performance under unconstrained conditions, actual revenue service must account for variability in train handling, infrastructure interactions, meets, and minor service disruptions.

Consistent with industry practice, schedule padding was applied as a percentage of simulated runtime to ensure proportional scaling across corridor lengths and operating speeds.

Components of Schedule Padding

Schedule pad values were structured to represent distinct operational uncertainty drivers rather than a single undifferentiated contingency factor. Each schedule includes allowances for:

Engineer Operating Variability

A base allowance was applied to reflect differences in train handling, braking profiles, acceleration behavior, and minor operational deviations that occur between crews and operating conditions. Even under automated train protection systems, variations in human response, weather conditions, and passenger loading influence achievable runtimes.

This component is consistent with allowances commonly applied in intercity passenger rail schedule development.

Passing Movements and Turnout Delays

For corridors incorporating single-track segments with passing sidings, additional allowance was applied to reflect:

- Diverging and converging movements at high-speed turnouts
- Temporary speed reductions associated with meet operations
- Variability in arrival sequencing

A supplemental allowance was included to reflect real-world dispatching variability and to preserve schedule robustness under minor operational disruptions.

Corridor Geometry and Design Uncertainty

Additional contingency was applied to greenfield corridors to reflect the uncertainty inherent in feasibility-level alignment definition. While least-cost-path and conceptual geometry modeling identify high-level corridors capable of supporting high-speed operation, subsequent engineering refinement often introduces:

- Localized curvature tightening to avoid environmental features
- Additional vertical profile constraints

These refinements typically result in localized speed reductions as alignments are finalized. The contingency allowance accounts for this expected change in performance without requiring detailed engineering at the feasibility stage.

Differentiated Pad by Corridor Type

Recognizing that not all alignments carry equal operational uncertainty, schedule pad values were differentiated based on corridor development context.

Previously Disturbed Corridors (Interstate and Adjacent Alignments)

For corridors utilizing existing or adjacent transportation rights-of-way, including interstate medians and established rail corridors, total schedule pad applied equals 8 percent, consisting of:

- 4 percent locomotive engineer operating variability allowance
- 4 percent allowance for scheduled meets and turnout-related delays

These corridors benefit from relatively flat terrain and limited vertical geometric constraints, with established grading profiles and primary speed restrictions driven by horizontal curvature.

Greenfield Corridors

For newly developed greenfield alignments, total schedule pad applied equals 20 percent, consisting of:

- 4 percent locomotive engineer allowance
- 4 percent scheduled meet allowance
- 12 percent contingency for future geometric constraints

The additional contingency reflects uncertainty associated with refining least-cost-path corridors into specific alignments that may require sharper curvature to avoid environmental or physical obstacles and the greater likelihood of speed reductions.

Service Planning Implications

The operating assumptions produce schedules that:

- Reflect realistic high-speed rail performance under feasibility-level infrastructure definition
- Maintain consistency across corridor alternatives for comparative evaluation
- Capture impacts of infrastructure configuration on runtime and reliability
- Support hourly base service with efficient fleet utilization

The application of higher schedule pad values to greenfield corridors appropriately reflects increased design uncertainty while preserving the potential for superior long-term performance once alignments

are refined.

Summary

The operations analysis framework combines simulation-based runtime modeling with allowances for real-world operating variability, infrastructure configuration, and service planning best practices.

This operating framework provides a robust foundation for ridership forecasting, financial analysis, and phased implementation planning for the Illinois High-Speed Rail Study. Further refinement of operating assumptions will occur in subsequent project phases as corridor alignments and infrastructure configurations are advanced.