Challenges of Concurrent Maintenance During Turnaround Events: Impact Analysis on Safety, Resources, and Execution

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EXECUTIVE SUMMARY

The integration of routine maintenance activities with planned turnaround events presents a complex challenge for refineries and chemical production facilities. Through careful analysis of operational practices, this white paper reveals the intricate interplay between resource allocation, safety management, and schedule coordination. These factors significantly influence both the execution of turnaround events and the effectiveness of routine maintenance operations. Our findings suggest that while concurrent maintenance during turnarounds offers potential efficiency gains, it requires sophisticated management approaches and meticulous planning to mitigate associated risks and challenges.

INTRODUCTION

Turnaround events stand as pivotal moments in facility operations, representing carefully orchestrated periods when facilities undergo comprehensive maintenance, strategic upgrades, and critical inspections during planned shutdowns. The complexity of these events increases substantially when organizations attempt to integrate routine maintenance activities and capital project work during these already intensive periods. This integration, while potentially efficient from a shutdown utilization perspective, introduces a multifaceted challenge that demands sophisticated management approaches and precise resource coordination. As industry veterans often note, "adding complexity never makes anything easier" – a principle particularly relevant when considering the intricate nature of concurrent maintenance during turnarounds.

OVERVIEW OF CONCURRENT MAINTENANCE CHALLENGES

Scope Discipline Fundamentals

The foundation of successful turnaround execution begins with rigorous scope discipline and optimization. A fundamental principle of turnaround management dictates that work scope should be strictly limited to activities that can only be completed during a full unit outage and are necessary to ensure reliable operation through the next operational period. This principle exists for sound operational and economic reasons: every additional task during a turnaround event increases complexity, resource demands, and the potential for schedule delays. Industry analysis demonstrates that any scope executed during a turnaround is 2.7 times more expensive than during normal operations.

An optimized scope delivers several critical benefits:

- Reduces turnaround duration through focused execution of essential tasks
- Reduces turnaround costs by minimizing premium-rate work
- Minimizes the risk of turnaround-related operational trips through reduced system interactions
- Improves overall reliability and extends turnaround intervals through strategic work selection

By definition, routine maintenance tasks are those that can be safely and effectively executed during normal operations. These activities are designed and planned for completion during operational periods, with appropriate safety measures and procedures already established for online execution. When organizations attempt to incorporate routine maintenance into turnaround events, they violate this basic scope discipline principle, introducing unnecessary complexity to an already challenging process.

The distinction between turnaround-appropriate work and routine maintenance is not arbitrary. It reflects careful consideration of the following:

- Safety requirements and risk management capabilities during operating periods
- Resource optimization across the facility's maintenance lifecycle
- Critical path management and schedule control
- Cost-effective distribution of maintenance activities
- Optimal use of unit downtime periods

Deferred Maintenance Impact

One of the primary drivers for including routine maintenance in the turnaround scope is the accumulation of deferred maintenance. When routine maintenance falls behind schedule due to resource constraints, operational demands, or other factors, organizations often view turnarounds as an opportunity to "catch up" on this backlog. While this approach might seem practical from a short-term perspective, it introduces several significant challenges:

- It masks underlying issues with routine maintenance program effectiveness
- It creates artificial resource competition between true turnaround work and catch-up maintenance
- It can lead to the normalization of deferral, where teams begin to rely on turnarounds as a solution for maintenance backlogs
- It potentially compromises the effectiveness of both the turnaround and the routine maintenance program

Significant deferred maintenance often indicates systemic issues within the maintenance program that must be addressed through programmatic improvements rather than scope expansion during turnarounds.

Impact of Scope Expansion

When organizations deviate from strict scope discipline by incorporating routine maintenance into turnaround events, they face several immediate challenges:

- Operational Impact: Including non-critical work extends the duration of high-risk unit shutdown and startup periods. These critical turnaround phases carry inherent risks that should not be prolonged without compelling operational necessity.
- Resource Dilution: Adding routine maintenance tasks diverts critical resources from turnaround-specific work. This dilution of focus and resources can compromise the

quality and efficiency of essential turnaround activities that truly require unit shutdown conditions.

- Complexity Escalation: Each additional maintenance activity introduced into the turnaround scope creates new interfaces, dependencies, and coordination requirements. This increased complexity exponentially compounds the challenges of planning, scheduling, and execution.
- Risk Multiplication: Integrating routine maintenance work introduces additional risk factors without proportional benefit, as these tasks could be completed during normal operations with established safety protocols.

SAFETY IMPACT ANALYSIS

Integrating routine maintenance activities during turnaround events introduces significant complexities to safety management protocols and communication systems. This comprehensive analysis examines the multifaceted safety challenges that arise when facilities attempt to balance multiple work streams while maintaining rigorous safety standards.

Increased Safety Management Complexity

The density of concurrent work activities in operating units during combined maintenance and turnaround operations fundamentally changes the safety management landscape. When multiple teams operate simultaneously in shared spaces, the complexity of safety oversight increases exponentially. The confined space entry requirements multiply, not merely in number but in complexity, as teams must coordinate access, monitoring protocols, and rescue readiness across various work fronts.

Hot work permit demands surge during these periods, necessitating more sophisticated fire prevention and monitoring systems. Safety teams must manage an increased number of simultaneous hot work operations while ensuring adequate fire watch coverage and maintaining clear emergency response pathways. This increased activity level requires enhanced coordination between safety personnel, operations teams, and contractors to maintain proper oversight and emergency preparedness.

Implementing lock-out/tag-out procedures becomes particularly challenging during concurrent operations. Multiple work groups may require access to the same systems or equipment, creating complex isolation scenarios that demand rigorous verification protocols. Safety teams must ensure that all isolation points remain secure while managing the needs of different work groups, often requiring enhanced documentation and communication systems to prevent isolation breaches.

Communication Challenges

Radio Traffic and Channel Management

The presence of multiple contractor organizations operating simultaneously introduces intricate communication challenges that require sophisticated management approaches. The sheer volume of radio traffic during concurrent operations can overwhelm traditional

communication channels, creating potential safety risks if critical information fails to reach its intended recipients. Organizations must implement carefully structured communication protocols prioritizing emergency and safety-critical messages while maintaining efficient work-related communications.

Emergency Response Coordination

Coordinating emergency response plans becomes particularly complex when managing multiple work groups with different safety protocols and evacuation procedures. Each contractor organization typically brings emergency response procedures, which must be integrated into a cohesive site-wide emergency management system. This integration requires:

- Development of unified emergency response protocols
- Regular coordination meetings between safety teams
- Integrated emergency communication systems
- Clear chains of command during emergencies
- Regular drills involving all contractor organizations
- Standardized emergency reporting procedures

RESOURCE COMPETITION

The management of resources during concurrent maintenance and turnaround events presents significant challenges that extend beyond simple scheduling. These challenges manifest most prominently in two critical areas: skilled labor allocation and management resources.

Skilled Labor Allocation

The competition for specialized craft workers during concurrent operations creates a complex resource management challenge. When facilities attempt to execute routine maintenance alongside turnaround activities, they often compete for the same pool of highly skilled workers. This competition extends beyond human resources to include critical equipment and tools, which must be carefully allocated across multiple work streams.

The demand for technical specialists becomes particularly acute during these periods, as their expertise is often required simultaneously across different aspects of the operation. This creates a complex crew scheduling environment where managers must balance the needs of three distinct work streams while maintaining operational efficiency. The situation inherently carries a higher risk of resource conflicts, as unexpected developments in any work stream can rapidly cascade into resource allocation challenges across the entire operation.

Management Resources

The strain on project management personnel during concurrent operations cannot be overstated. These key personnel must navigate an increasingly complex web of responsibilities, including managing multiple QA/QC requirements and teams, ensuring

comprehensive safety oversight, and coordinating complex permitting requirements. The demand for additional engineering support further complicates the resource allocation, as technical expertise must be carefully distributed across all ongoing activities.

CAPITAL PROJECT INTEGRATION CHALLENGES

The intersection of capital projects with turnaround events creates a complex web of organizational and logistical challenges. At the heart of these challenges lies the intricate task of multi-team coordination, where diverse groups must work in harmony despite different operational philosophies and objectives. Project teams, maintenance crews, and turnaround specialists must navigate a shared workspace while managing distinct priorities and methodologies.

The complexity begins with interface management, where multiple teams must coordinate their activities while maintaining clear lines of communication and responsibility. These teams often bring different execution philosophies to the table, with project teams typically focusing on long-term deliverables while maintenance teams prioritize immediate operational reliability. This philosophical divergence requires careful stakeholder management across organizational boundaries to ensure alignment toward common goals.

Schedule integration presents another layer of complexity in capital project coordination. Managing triple critical paths—encompassing maintenance, turnaround, and project activities—requires sophisticated planning and constant vigilance. Project managers must carefully orchestrate milestone interdependencies while accounting for extended system outage requirements necessary for project tie-ins. The risk of delays in any single area can create a cascading effect across all work streams, particularly during crucial commissioning activities where system availability becomes a critical factor.

FINANCIAL IMPLICATIONS

Cost Comparison Analysis

The financial impact of executing routine maintenance during turnaround events versus normal operational periods requires careful analysis. Understanding these cost differentials is crucial for making informed decisions about scope inclusion and resource allocation. While specific cost data varies by industry and region, several key cost factors consistently drive higher execution costs during turnaround events.

Labor Rate Differentials represent a significant cost escalation factor during turnarounds:

- Base craft rates typically increase by 15-30% during turnarounds due to premium pay requirements and market demands
- Standard overhead multipliers expand significantly during turnarounds due to additional management layers and support services
- Regular supervision ratios shift from typical 1:8-10 during routine maintenance to as high as 1:5-6 during turnarounds, increasing overall labor costs

Productivity Factors further compound the cost differential:

- Normal maintenance productivity rates typically decrease by 20-40% during turnarounds due to congestion, interference, and complex coordination requirements
- Standard work hours transition to extended shifts and overtime scenarios, often resulting in premium pay multipliers of 1.5 to 2.0 times base rates
- Single shift operations expand to multiple shifts, introducing shift differential premiums and reduced efficiency due to handover requirements

Support Cost Loading introduces additional overhead:

- Regular planning ratios of 1:20-25 (planners to crafts) typically increase to 1:10-15 during turnarounds
- Standard safety oversight expands to include dedicated safety teams, additional permit writers, and increased monitoring requirements
- Normal coordination structures grow to include turnaround-specific management teams, scheduling specialists, and additional administrative support

The cumulative effect of these factors often results in routine maintenance work executed during turnarounds costing significantly more than the same work performed during normal operations. This cost premium must be carefully weighed against any perceived benefits of concurrent execution.

Budget Management

Managing budgets across concurrent operations demands a nuanced financial planning and control approach. The complexity begins with tracking costs across multiple categories, particularly when distinguishing between capital and expense allocations. Organizations must coordinate multiple funding sources while maintaining clear boundaries between cost centers and project types.

The risk of cost overruns becomes more pronounced in this environment, as changes or delays in one area can have ripple effects across multiple budgets. This interconnectedness requires sophisticated contingency management strategies to account for the complex interplay between different work streams while maintaining financial control.

Cost Control

Implementing effective cost-control measures requires increasingly sophisticated systems and processes. Organizations must develop and maintain complex cost coding structures that accurately track expenses across multiple work streams while ensuring proper allocation between capital and expense categories. This complexity extends to approval hierarchies, which must balance careful oversight with the requirement for timely decision-making.

KEY RISK FACTORS

Technical Risks

The technical complexity of concurrent operations creates multiple points of potential failure that require careful management. System isolation requirements become particularly challenging when managing multiple work fronts simultaneously, often requiring sophisticated temporary facility arrangements to maintain essential services while work proceeds. The increased number of concurrent activities also leads to higher lifting and logistics complexity as multiple teams compete to access critical areas and resources.

The risk of interference between work fronts grows exponentially with the number of concurrent activities. Teams must carefully coordinate their activities to prevent conflicts compromising safety or work quality. This coordination becomes particularly critical during complex commissioning sequences, where system availability and testing requirements must be carefully balanced against ongoing work needs.

Equipment Reliability Impacts

A critical but often overlooked risk of including routine maintenance in turnaround scope is the potential for infant mortality failures. When equipment that is operating reliably is unnecessarily opened, inspected, or maintained, organizations introduce several significant risks:

- Breaking of established sealing surfaces and joint integrity
- Potential contamination during inspection or repair activities
- Disruption of stable operating conditions
- Introduction of assembly variables with new parts or gaskets
- Creation of new potential failure points through disassembly/reassembly

The "if it isn't broken, don't fix it" principle applies particularly well to equipment performing reliably. Industry experience shows that unnecessary maintenance interventions can lead to a spike in early-life failures during the post-turnaround period, often requiring unplanned outages or emergency repairs. This phenomenon directly contradicts the goal of improving reliability through expanded maintenance scope.

Operational Risks

The impact of concurrent activities extends beyond the execution phase into facility startup and ongoing operations. Extended startup curves become more likely as teams simultaneously navigate the complexity of returning multiple systems to service. The need for numerous system testing requirements and complex handover procedures between different work groups further compounds this complexity.

The increased potential for startup issues stems from the intricate interdependencies between systems and the challenge of ensuring all work has been properly completed and verified. These challenges create a higher risk of production impacts, as delays or complications in one area can affect the entire startup sequence.

EXECUTION COORDINATION: ENABLING REAL-TIME DECISION-MAKING

Successfully executing concurrent maintenance during turnaround events hinges on the organization's ability to coordinate multiple work streams while maintaining clear visibility of progress, risks, and resource utilization. As work scopes expand and interfaces multiply, traditional coordination methods become inadequate for managing the increased complexity. Organizations must establish robust frameworks that enable rapid, informed decision-making based on real-time information from all aspects of the operation. This comprehensive approach to execution coordination serves as the central nervous system of the entire operation, providing leadership with the tools and information needed to maintain control and respond effectively to emerging challenges.

Integrated Command Center

The heart of effective execution coordination lies in establishing a centralized command center capable of monitoring and managing all concurrent activities. This command center must incorporate real-time visualization and tracking systems that provide comprehensive visibility across all work streams. Integrating maintenance, turnaround, and project monitoring capabilities enables effective coordination while maintaining clear lines of authority and responsibility.

Immediate escalation protocols ensure that critical issues receive prompt attention from appropriate decision-makers. Cross-functional coordination teams within the command center help maintain communication between work groups while ensuring effective resource allocation and problem resolution.

Information Management

Successful execution coordination depends on sophisticated information management systems that support effective decision-making. Implementing performance dashboards provides leadership with critical insights into work progress and potential issues. Digital tracking and verification systems ensure accurate data collection while maintaining regulatory compliance.

Decision Support Systems

Leadership Visibility: Effective decision-making during concurrent operations requires comprehensive visibility into all aspects of execution. Executive-level performance indicators provide leadership with critical insights into progress and potential issues. Resource optimization tools help maintain efficient allocation of personnel and equipment across different work streams.

Response Management: Effectively responding to emerging issues requires clear protocols and communication channels. Well-defined escalation pathways ensure critical decisions receive appropriate attention while maintaining work progress. Standardized decision protocols help maintain consistency while ensuring proper authority for critical choices.

RECOMMENDATIONS FOR MANAGING CONCURRENT MAINTENANCE

Risk Mitigation Strategies

Effective planning forms the foundation for successful concurrent maintenance execution. Organizations should implement dedicated planning teams specifically focused on routine maintenance activities, allowing for specialized attention to these tasks while maintaining coordination with turnaround planning efforts. These teams should work within integrated scheduling systems that provide visibility across all work streams while maintaining clear boundaries between activities.

Systematization Framework

Successfully integrating concurrent maintenance activities requires careful attention to system architecture and process standardization. Organizations must address several key challenges to create effective frameworks for managing these complex operations:

System Architecture Considerations:

- Compatibility between turnaround planning tools and routine maintenance systems
- Data standardization across multiple platforms
- System integrity maintenance during high-volume periods

Process Standardization:

- Unified documentation standards
- Consistent KPI tracking methodologies
- Cross-functional approval workflows

Digital Integration Opportunities

Modern digital tools provide significant opportunities for improving the management of concurrent maintenance activities:

Work Management Systems:

- Integrated permit-to-work systems
- Unified resource tracking and allocation
- Automated schedule conflict detection
- Real-time progress tracking and reporting

Digital Twin Applications:

- Asset health monitoring during concurrent activities
- Predictive maintenance integration
- Three-dimensional visualization of work zones
- Resource movement and work front tracking

Systematic Risk Management

The implementation of data-driven decision-making processes helps organizations manage risks more effectively during concurrent operations:

- Historical performance analysis integration
- Risk assessment standardization
- Automated conflict detection and resolution
- Predictive analytics for resource optimization
- Standardized quality control procedures
- Digital documentation and traceability systems

CONCLUSION

Integrating concurrent maintenance activities with turnaround events represents a complex challenge that requires sophisticated management approaches and careful attention to execution details. Organizations can successfully navigate these challenges through effective coordination structures, robust information management systems, and clear decision-making protocols while maintaining safety, quality, and efficiency standards.

Success in this environment requires:

- Comprehensive planning and preparation
- Robust coordination systems and protocols
- Clear lines of authority and responsibility
- Effective information management capabilities
- Rapid response protocols for emerging issues
- Continuous monitoring and adjustment of execution strategies

By carefully considering these factors, organizations can achieve successful outcomes in concurrent maintenance execution while maintaining operational excellence and safety standards.

ABOUT THE AUTHOR

John Crager brings over 40 years of practical industrial maintenance and capital project leadership within the industry. Currently Vice President and General Manager at APVantage LLC, John combines practical expertise with strategic vision in process improvement and operational excellence. His career progression from starting as a unit operator and millwright to leading large capital programs has provided unique insights into every aspect of industrial operations. A published author and certified professional (CMRP, PMP, Six Sigma Master Black Belt) with an MBA and BS in Industrial Management, John specializes in transforming complex operational challenges into practical, effective solutions.

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