



# CHESB Batch Settlement

## Incident Review

**Incident date: 20 December 2024**

**Publication date: 23 January 2025**

## 1. Context

This document has been prepared to provide further information to ASX customers and stakeholders on the CHES Batch Settlement incident that occurred on 20 December 2024.

Capitalised terms not defined within this document have the meanings given in the ASX Settlement Operating Rules, all times are in Australian Eastern Daylight Time and any references to ASX refer to ASX Settlement Pty Limited unless otherwise noted.

## 2. Background

For cash equities settlement in Australia, settlement occurs on a T+2 basis—that is, two Business Days after a trade is executed. The CHES system facilitates the transfer of legal ownership of the cash market products and coordinates the simultaneous exchange of funds between Participants and their respective banks.

CHES employs a batch settlement process which involves the netting of all buy and sell transactions per security for each Participant for a given day. Each Business Day, Batch Settlement typically begins at 11:30am. During this process, ASX calculates each Participant's net funding and securities delivery obligations, and the aggregated net funds positions of all participating financial institutions (payment providers). ASX then uses multilateral netting to settle both novated (i.e. market trades) and non-novated trades.

## 3. Incident summary

On Friday 20 December 2024 Batch Settlement could not proceed because a critical step in the settlement process generated an error that prevented completion. ASX was not able to resolve the error before the relevant cut-off time on Friday and therefore rescheduled settlement obligations to the following Business Day, Monday 23 December 2024.

A single Batch Settlement occurred on 23 December 2024, including trades executed on 18 December 2024 (the trades which had been rescheduled), and trades executed on 19 December 2024 which settled in the ordinary course of the T+2 settlement cycle. The process to reschedule CHES transactions is standard CHES functionality, albeit usually carried out on a much smaller scale, and was completed without incident.

ASX had identified a possible workaround late on Friday afternoon, however investigations over the weekend allowed ASX to identify the cause of the error in the CHES code, and a fix was developed, tested and implemented on Sunday 22 December 2024. CHES became available at the usual time on Monday 23 December 2024 and Batch Settlement commenced at 12:30pm, one hour later than usual (following Participant requests for an extension), successfully completing at 1:08pm the same day.

Since the error only affected Batch Settlement, trading and related clearing continued as normal on Friday 20 December 2024 and the market opened without issue on Monday 23 December 2024.

## 4. Chronology of incident identification and resolution

On Friday 20 December 2024, shortly following the commencement of Batch Settlement, ASX system monitoring detected an issue with the Batch Settlement process. Initial investigations by ASX engineers confirmed an error was preventing the process from completing and communications were issued at 12:05pm notifying users that Batch Settlement would be delayed. This information was published to the ASX System Status Page (System Status Page) and directly issued to users via email.

The following is a chronology of the key events.

Time (AEDT)	Event
<b>Friday 20 December 2024</b>	
11:32am	<p><b>Incident alert issued</b></p> <p>Batch Settlement could not proceed because a critical step in the settlement process (Funds Authorisation process) generated an error that prevented completion.</p>
12:05pm	<p><b>First public notification</b></p> <p>ASX posted an update on the System Status Page, alerting Participants to the issue.</p>
12:17pm – 12:19pm	<p><b>First regulatory notification</b></p> <p>ASX notified its regulatory agencies, Reserve Bank of Australia (RBA) and Australian Securities and Investments Commission (ASIC), of an issue with completing Batch Settlement.</p>
12:00pm – 5:00pm	<p><b>Incident management actions</b></p> <ul style="list-style-type: none"> <li>ASX activated its Incident Management process, convened the team, and had engineers investigate and attempt resolution, including error reproduction in test environments.</li> <li>ASX contacted the RBA's Payments Settlements team, Participants from a cross section of categories and payment providers about the contingency event and delayed CHES batch submission to Reserve Bank Information and Transfer System (RITS).</li> <li>ASX Operations and Technology commenced preparation of operational contingency actions required if Batch Settlement could not complete as expected.</li> <li>Regular updates were published to the System Status Page (a total of 20 updates were made on 20 December 2024).</li> <li>Regular regulatory agency briefings.</li> </ul>
5:05pm	<p><b>ASX begins work stream to reschedule Batch Settlement to Monday 23 December 2024</b></p>
5:15pm – 5:40pm	<p><b>Regulatory agencies notified of intention to reschedule Batch Settlement to Monday 23 December 2024</b></p>
5:55pm	<p><b>Market notification of reschedule of Batch Settlement</b></p> <p>ASX announced it was unable to resolve the issue in time and would reschedule the Batch Settlement. Industry call invitation for 6:30pm issued.</p>
6:30pm – 7:08pm	<p><b>ASX hosts industry call</b></p>
6:31pm	<p><b>ASX engineering team identify a potential workaround</b></p> <p>The workaround would require testing and validation.</p>
7:30pm	<p><b>Batch Settlement rescheduled</b></p> <p>Batch Settlement for 20 December 2024 was rescheduled to 23 December 2024. An overview of the mechanics of that process is set out below.</p>
<b>Saturday 21 December 2024</b>	
<p><b>Ongoing incident management actions</b></p> <p>The ASX engineering and support teams continued root cause analysis as well as preparing and testing a potential workaround solution and contact was made with Approved Market Operators (AMOs) to communicate the incident status. Regulatory agencies, Incident and Crisis Management Teams meetings continued throughout the day.</p>	

Sunday 22 December 2024	
10:30am	<b>Fix identified</b> ASX engineering team identified the fix required to rectify the Batch Settlement issue leading to the prioritisation for ASX to develop, test and deploy the fix.
4:10pm	<b>Emergency software release deployed</b> Fix was implemented to address the issue.
5:00pm – 5:25pm	<b>ASX hosts industry call</b>
Monday 23 December 2024	
5:00am	<b>CHES Start of Day</b> CHES Start of Day commenced successfully at the normal time.
12:30pm – 1:08pm	<b>Batch Settlement</b> Batch Settlement started and successfully completed, covering both rescheduled and scheduled obligations.

### Friday 20 December 2024: incident emerges and initial response

On Friday 20 December 2024, shortly following the commencement of Batch Settlement, ASX system monitoring detected an issue with the Batch Settlement process. Initial investigations by ASX engineers confirmed an error was preventing the process from completing and communications were issued at 12:05pm notifying users that Batch Settlement would be delayed. This information was published to the System Status Page and directly issued to users via email.

During the afternoon, ASX began pursuing several streams of work to manage the incident. Engineers and business experts were seeking to identify the cause of the issue so that a fix could be deployed. Separately work was underway to prepare for an outcome where a resolution could not be successfully deployed, and the market would need to be prepared to delay Batch Settlement to Monday 23 December 2024. At the same time, ASX teams were supporting communicating the status of the incident to stakeholders across standard channels.

A critical factor was whether ASX could implement a suitable resolution in time to meet the RITS Daily Settlement Session deadline. Although the usual cut-off is 4:30pm, ASX secured an extension to 5:30pm in order to resolve the issue. A subsequent extension to 6:00pm was granted so that ASX would have sufficient time to communicate to the market and begin the process to reschedule Batch Settlement. During this time engineers had traced the problem to a record failing to persist in system memory, however a solution had not been identified that could be implemented in time.

At 5:05pm, there was not yet a clear path to resolution. ASX started preparations to reschedule the existing Batch Settlement to Monday 23 December 2024. By 5:15pm, meetings were convened with the regulatory agencies to communicate that a timely resolution was not achievable. Upon concluding those discussions, ASX sent invitations for an industry call via the System Status Page and email. At 5:55pm, ASX announced on the System Status Page that it would need to reschedule Batch Settlement to Monday 23 December 2024.

An inability for CHES to complete Batch Settlement on the same day is not something that has happened before. This was a unique challenge, and the team was only able to identify a potential workaround by 6:31pm. By this time, the RITS cut-off had passed, and the industry call was already taking place to plan for delayed settlement. It should be noted that even as the potential workaround had been identified, more time for preparation and testing was required to provide the requisite certainty it would work as required.

At 7:30pm ASX ran the “stop settlement process” in CHES. This is the standard procedure executed in CHES to cancel batch settlement on a day, as contemplated under the ASX Settlement Operating Rules and the CHES Payments Interface Standard Payments Provider Deed.

The “stop settlement process” was affected by cancelling all Settlement Instructions (i.e. instructions to ASX to effect settlement) for Friday 20 December 2024 and rescheduling those Batch Instructions to Monday 23 December 2024.

## Saturday 21 December and Sunday 22 December 2024: fix and workaround

The incident's timing on a Friday meant ASX went into the weekend planning both to develop and test a fix, while also testing the workaround as a fallback. On Saturday 21 December 2024, ASX engineers continued to investigate the root cause, working in parallel to validate the workaround process.

On Saturday preliminary testing indicated the workaround was viable, but ASX decided to wait until midday on Sunday to see if a fix could be finalised before further testing on the workaround. Had a fix been deemed not possible by that time, further testing and validation of the workaround would have taken place to ensure readiness for Monday.

By Sunday morning, around 10:30am, ASX confirmed the cause of the incident which enabled the decision to focus on developing and testing the fix. With the solution identified at this time, additional workaround testing was less of a priority. At 11:38am on Sunday, ASX invited all Participants to a 5:00pm industry call via the System Status Page. Around 4:00pm, the emergency software release was deployed successfully, and ASX briefed the regulatory agencies on the resolution. At the 5:00pm call, ASX announced that CHES would operate as expected on Monday 23 December 2024, and that Batch Settlement would commence 30 minutes later than usual to accommodate any remaining exceptions.

## Monday 23 December 2024: successful settlement completion

On Monday morning, CHES opened at its normal Start of Day time, allowing registries, Participants and AMOs to proceed with standard processing. Trade clearing commenced without issue. At the request of Participants, ASX extended the Batch Settlement start by an additional 30 minutes to 12:30pm. Batch Settlement then completed successfully at 1:08pm, finalising trades from 18 and 19 December 2024.

## Market and regulatory agencies engagement

ASX employs a comprehensive multi-channel approach to engage with stakeholders during incidents. This approach ensures timely and effective communication through various platforms:

- **System Status Page:** Accessible on the [ASX website](#), this page provides real-time updates on key system outages, incidents and resolutions. Users can subscribe to receive notifications via email or mobile for systems relevant to them, ensuring they stay informed.
- **Email campaign updates:** Regular email updates are sent to stakeholders, providing information about the incident, and the steps being taken to resolve it.
- **Bilateral meetings and phone calls:** Direct communication through one-on-one video conferencing meetings and phone calls.
- **Industry briefings via web conferencing:** During this incident ASX conducted industry briefings through web conferencing, providing a forum for broader communication with multiple stakeholders. These briefings provided an avenue for live Q&A and was used to deliver detailed insights into the incident, its implications and the measures being implemented to resolve it.

As noted above, communications alerting customers to an incident emerging first began at 12:05pm on Friday 20 December. Ongoing updates and regulatory engagement proceeded from that point.

ASX recognised the importance of regular stakeholder communication throughout this incident. A total of 20 updates were published on the System Status Page during 20 December 2024, ensuring that Participants and the broader public were kept informed of developments. In addition, ASX introduced banner updates on its website homepage from approximately 5:45pm, mirroring the messages posted on the System Status Page and conducted several bilateral meetings to assess the customer impact of rescheduling Batch Settlement.

All bilateral meetings on Friday 20 December confirmed the industry's strong preference to complete Batch Settlement, if possible, on that day rather than reschedule to Monday. That is, the industry preference was for ASX to continue to pursue finding a fix, even if it meant Batch Settlement ran late.

Once it became clear that a fix or workaround could not be implemented in time on Friday evening, ASX booked an industry briefing call for 6:30pm. This call featured a live question-and-answer session. ASX outlined the incident's progression over the course of the afternoon and confirmed plans to reschedule all Batch Settlements at 7:30pm, after which CHES would return to normal processing. ASX also announced a three-hour extension to the commencement of the CHES End of Day (EOD) process, which would now begin at 10:00pm, thereby allowing Participants to continue processing transactions in CHES until that time. Over 370 individuals joined this 6:30pm industry call, during which the rescheduled settlement and subsequent operational steps were clearly communicated.

## 5. Root cause analysis

### Overview

A combination of factors triggered the incident.

As background, ASX's CHES system runs on the OpenVMS operating system, a mature and stable operating system, which manages memory through multiple "global sections". One such section, the "Users Global Section", stores and manages user-related data for the CHES Batch Settlement application. Within the system, there is memory allocation logic which considers how many records are required in the "Users Global Section" for the batch settlement process, by considering the total number of authorised CHES Batch Settlement users, plus a buffer. Memory is allocated in "pages" and a page of memory holds a certain number of records, and when more records are required, additional pages are allocated accordingly.

The root cause of the incident can be ultimately traced back to the introduction of a product called mFund in 2014. mFund enables investors to access unlisted managed funds via their broker using CHES, and in Batch Settlement, each individual mFund with transactions settling on a given day generates an additional record within the CHES "Users Global Section" page.

When mFund was initially launched in 2014, ASX did not identify the need to make required changes to this specific piece of CHES memory provisioning logic to accommodate a new mFund settlement user type. This left an error in the memory allocation logic in the "Users Global Section" page. Although this error remained in the system since 2014, other buffers and parameters within CHES meant it did not impact system behaviour until specific circumstances in December 2024 caused the system logic to assign insufficient memory to handle the number of users in Batch Settlement for that day.

By 20 December 2024, a recent user removal had reduced the calculated number of lines required, and thereby reduced the total allocated "Users Global Section" pages by one, eliminating the headroom previously provided by the mostly empty final page. When the actual number of users exceeded the allocated page capacity, the Batch Settlement process was not able to complete successfully.

It should be noted that CHES has operated successfully with significantly more active users than the number on 20 December 2024, however, the specific circumstances on 20 December 2024 caused the memory allocation issue.

### Outcome and analysis

Technical analysis confirmed that the incident was specifically related to the CHES memory allocation logic—unrelated to the operating system, hardware, database or overall system capacity. No business data was corrupted, and data integrity was not compromised during the incident. Additionally, there were no indications of malicious activity.

### Resolution

Once the memory allocation issue was understood, ASX implemented an immediate fix to update the memory allocation logic and ensure the Users Global Section had sufficient capacity. This solution addressed the cause, preventing further occurrences of the error and restoring Batch Settlement to normal, stable operation.

## 6. Ensuring the stability of CHES

In April 2023, ASX released a Special Report detailing how it intends to maintain CHES and ensure its operational stability until 2032. Within that report, ASX reaffirmed its commitment to "investing in and enhancing CHES to support the long-term interests of Australia's financial markets while meeting all relevant regulatory requirements, including the Financial Stability Standards." This commitment remains firmly in place.

Since publishing the Special Report, ASX has implemented several key upgrades and enhancements to CHES, including comprehensive capacity testing. In parallel, work continues on the replacement CHES system, which will be rolled out in two stages. We continue to work towards delivery of Clearing in mid-March to end-April 2026, followed by Settlement and Subregister in 2029. While the incident described above was an irregular event that had not been anticipated, ASX is focused on learning from it. The root cause has been identified and resolved. Nevertheless, this occurrence underscores the importance of ongoing oversight of CHES resilience. Consequently, ASX is reviewing its

commitments and work plan to ensure CHES remains stable, robust and capable of providing uninterrupted clearing and settlement services for the market.

### Actions following Batch incident

ASX has developed a preliminary Action Plan in response to the recent incident. This plan encompasses a series of strategic actions aimed at:

- Addressing the immediate incident and any post-incident activities.
- Ensuring the ongoing stability of CHES by evaluating the need for any additional controls or technology modifications.
- Assessing the effectiveness of ASX's incident management and collaboration with industry stakeholders during and after the incident.
- Identifying opportunities for improvement of the operations resilience program both within ASX and in its interactions with the industry.

Further, ASX will conduct two Post Incident Reviews (PIRs) to refine this Action Plan. The PIRs will help ensure that necessary measures are taken to minimise the risk of future incidents and enhance overall system resilience.

The following table outlines the key actions being undertaken along with the status as at 23 January 2025:

No	Action	Status
<b>CHES Operating Environment Actions</b>		
1.	Detailed technical investigation of the root cause of the Batch Settlement issue and update support documentation	Completed
2.	Monitoring in place (operational) to ensure the number of required batch settlement users are within the available boundary	Completed
3.	Reassess the Emergency CHES Release and evaluate if further change is required for Users Global Section allocation	In progress
4.	Review calculation of the other CHES Settlement Global Section page allocation	In progress
5.	Review resourcing levels/capability for current CHES	In progress
6.	Review if there are any further areas of the CHES system that require enhanced technical controls	Planned
7.	Enhance the CHES resilience scenarios	Planned
<b>Post Incident Review Actions</b>		
8.	Complete internally focussed PIR of ASX processes and protocols for incident management including: <ul style="list-style-type: none"> <li>• The approach and roles in managing incident communications with Participants and CHES Users</li> <li>• The approach and roles in managing incident communications with the regulatory agencies</li> </ul> The review to provide a clear plan to address any identified improvements	Planned
9.	Complete externally focussed PIR with specific focus to: <ul style="list-style-type: none"> <li>• Engage with Participants and CHES Users to seek feedback on the communication processes both during and after the incident</li> <li>• Understand the impact of the Batch Settlement Issue on Participants and CHES Users</li> </ul> The review to provide a clear plan to address any improvement initiatives and actions	Planned

## 7. Impacts of the incident

Due to the incident, ASX postponed the Batch Settlement originally scheduled for Friday 20 December 2024, to Monday 23 December 2024—one Business Day later. This meant the market would complete one Batch Settlement on 23 December 2024 for market trades from 18 December 2024 and 19 December 2024. To facilitate this, all Batch Instructions—including novated cash CCP transactions from trade date 18 December 2024 and bilateral and unilateral settlements scheduled for 20 December 2024—were cancelled and rescheduled for 23 December 2024.

### Registration of market transactions

During the incident, AMOs continued submitting Market Transactions for registration with ASX Clear. CHESSE also maintained its dissemination of Broker-to-Broker Notifications (MT164s) to Clearing Participants as Market Transactions were registered.

### ASX Clear Margins

- ASX Clear typically receives payment for Cash Market Margin (CMM) and Exchange Traded Option (ETO) margins by 10:30am each day and pays out these funds following Batch Settlement, usually by 12:30pm. In keeping with the standard practice of not returning margins until the relevant day's Batch Settlement has occurred, CMM and ETO margins were not returned on 20 December 2024.
- The CMM calculations for the close of business on 20 December 2024 accounted for three days of unsettled trades (rather than the usual two) and were called and settled as required on Monday 23 December 2024.

### Inflight security events

- **Primary Market Facility:** the subregister for seven allocation interests that had been set up in CHESSE to support Primary Market Facility transactions deferred closure of register by one day to Tuesday 24 December 2024.
- **Corporate actions:** One listed company's buyback ex-date and record date were shifted by three Business Days.

Although the technical and operational steps to enact a delayed settlement were relatively straightforward, the ramifications for customers and Participants were significant. Some Participants took proactive measures, such as drawing on credit lines, to fulfil client expectations for payment on trades executed on Wednesday 18 December 2024.

## 8. Recognising market disruption and supporting our customers

ASX acknowledges the seriousness of its inability to complete Batch Settlement on 20 December 2024. The nature of this issue and how it arose was highly irregular and there is no record of previous incidents caused by this part of the system, or of CHESSE not completing Batch Settlement on a designated settlement day.

The unprecedented nature of this event led to considerable disruption of standard operating procedures for many Participants and customers. ASX recognises the steps taken by some Participants to mitigate the impact on their own clients.

ASX has waived all fail fees for the period from 20 to 31 December 2024 (inclusive).

In addition, to acknowledge the disruptive impact on our customers, ASX has established a \$1 million credit disbursement, which will be allocated in the form of a rebate to Settlement Participants. All Settlement Participants are eligible to participate in the rebate. The total amount to be shared will be distributed proportionate to each Settlement Participant's revenue contribution for the first half of FY25 (i.e. July 2024 to December 2024). The credit will be reflected in the invoice for February 2025.