TRANSPOWER

Generation Commissioning Process

The System Operator's guide for asset owners
to navigate smoothly through the commissioning phases

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1.0	02/07/2015	Issued
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Introduction

This document guides you, the asset owner, to understand and fulfil the requirements for commissioning generation and connecting to the New Zealand power system.

Transpower, acting as the System Operator, manages the overall flow of electricity across Transpower's high-voltage transmission network. We are responsible for ensuring electricity supply and demand are always in balance, and for connecting generators of electricity with electricity retailers through the wholesale electricity market. The System Operator supports asset owners to connect generating assets safely and in compliance with regulation. You can read more about this role on the *Our System Operator role* webpage.

You are responsible for:

- meeting your obligations in the *Electricity Industry Participation Code* (EIPC, or the Code), especially parts 8 and 13, as well as those in the *Connected Asset Commissioning, Testing and Information Standard* (CACTIS)
- collaborating proactively with the System Operator to coordinate commissioning milestones
- ensuring the strength, adequacy of design, and capacity of assets
- all the activities that lead to generation, including testing and modelling
- communicating with the System Operator clearly with the agreed regularity.

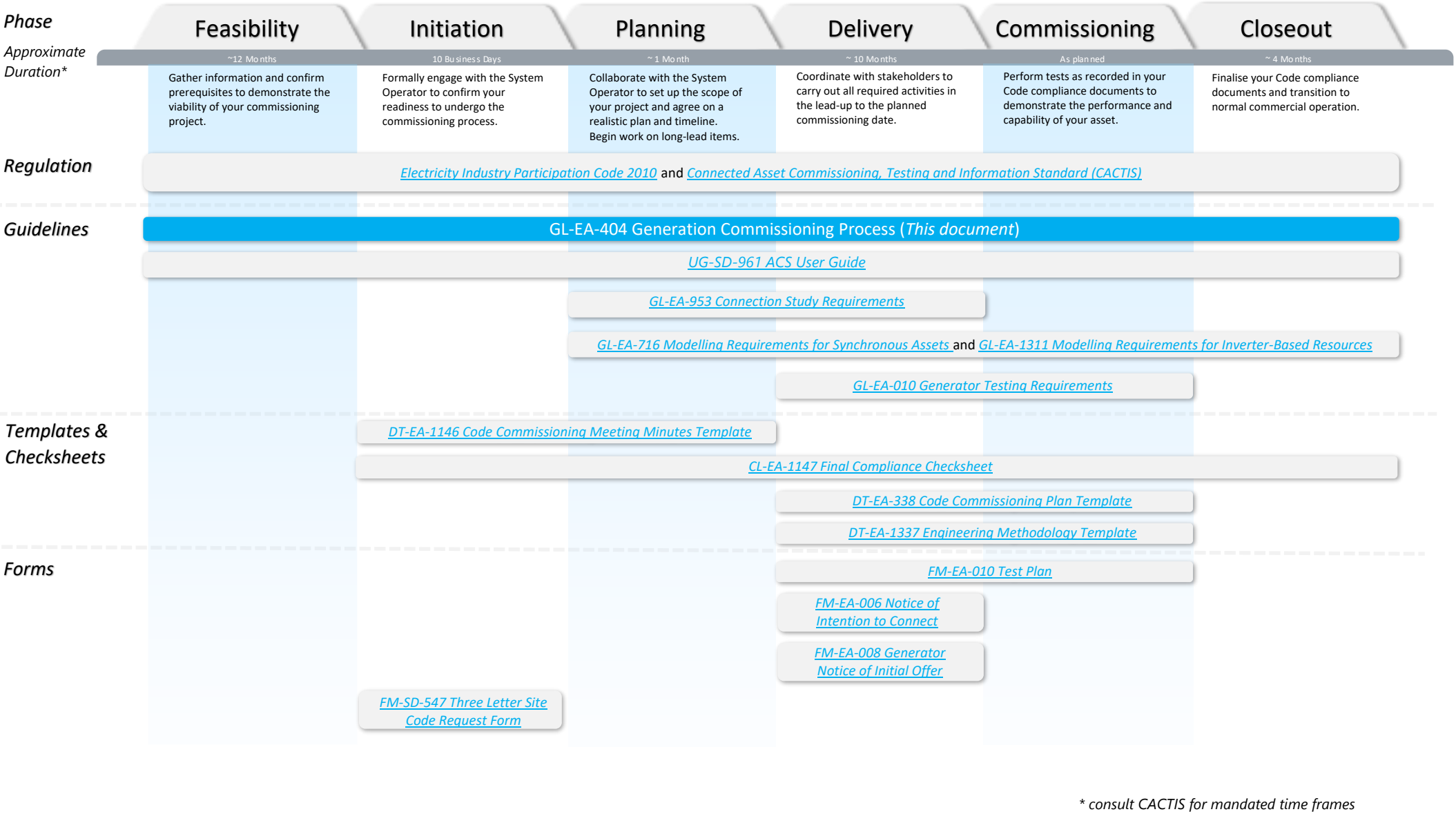
The System Operator aims to co-operate with you to achieve your goal of commissioning generation. To avoid any delays, it is essential you fulfil your responsibilities and pay particular attention to the timing and quality completion of all necessary activities.

While undergoing this process, the System Operator's guidance will refer you to other documents, forms, and templates from our *Commissioning Generation* webpage. On the following page, we have included a map of these documents with hyperlinks. The map indicates when you should consult or use each document during the commissioning process.

Refer to the guideline document you are currently reading for the 'what and when' of the process: a general overview of activities and the timing of all milestones, including long-lead items. Refer to the other guideline documents (marked with GL at the start, e.g. GL-EA-716) for the 'how': specific details, methods and measurements to carry out the activities. We expect you to use our templates (marked with DT at the start) and forms (marked with FM) which we have designed to facilitate your provision of the requisite information.

In line with good industry practice, we have prepared all our documents in consultation with the Code. We recommend you familiarise yourself with the Code, including with the provisions of the CACTIS, before beginning the commissioning process. It will be useful for you and any supporting consultants to also refer to the Code throughout the process.

Note that any guidance provided by the System Operator's documents is not prescriptive, and any review or approval from the System Operator does not relieve you from your obligations to continue meeting the requirements of the Code beyond the point of approval. If there is an inconsistency between a System Operator document and the Code, including the CACTIS, the Code will prevail to the extent of the inconsistency.



** consult CACTIS for mandated time frames*

How to read this document

The System Operator has designed this document to provide a 'big picture' view of the commissioning process. There are several features to support comprehension:

- When the word 'you' is used, it refers to the asset owner.
- When the word 'we' is used, it refers to the System Operator.
- Technical jargon (field-specific wording) only appears where strictly necessary – refer to the Code and individual Transpower documents for technical specifications relevant to each activity.
- There is a glossary at the end for acronyms and initialisms used.

Most commissioning activity descriptions also contain the following visual elements:

The red exclamation icon indicates that you must consult the specified chapter(s) of the CACTIS for the detail of obligations that apply in relation to this activity, including the time frames in which you must submit information to the System Operator. This is only listed as guidance only and may not exhaustively cover obligations that might be found elsewhere in the Code or in other documents incorporated by reference into the Code.

The blue clock icon is an indicator of the approximate duration and/or expected timing of the activity. For example, it may include advice on providing draft documentation ahead of submitting final copies. This time frame is provided as a guidance only; individual commissioning projects may vary. Your lead commissioning engineer will be able to provide timing information that is tailored more accurately to your project.

The System Operator recommends you read this document fully during the feasibility phase and then refer to it as you schedule the remaining phases and their associated requirements. If you are reading this on a screen, you can navigate easily between each of the sections of the document by clicking on the tabs that appear at the start of each section.

1. Feasibility

The feasibility phase is when you gather information about your proposed commissioning project to help prove that it is viable. During this phase, you need to confirm several prerequisites to demonstrate the project's certainty. These prerequisites vary depending on whether you are commissioning generation with a new asset (i.e. for the first time), or whether you are performing maintenance or upgrading an existing asset.

1.1 New Assets

We have provided the prerequisites for a new asset below, along with brief explanations why the System Operator requires these. Note that these milestones feature in the other workstreams within the *Generation Connection Guide* that are governed outside of the System Operator: to establish a connection to Transpower's transmission system (or a Distributor network), and to build an ICCP interconnection. The guide also contains a diagram showing how the timing of those workstreams aligns with the phases of the commissioning process. Once your application to connect to either the power system has been reviewed and approved, you should begin working on the feasibility milestones.

Milestone	Why is this important?
You have submitted an early planning asset capability statement (ACS).	This helps the System Operator understand your asset's technical capabilities and assess its potential impact on the power system. You can find more information about completing your ACS on the *Asset Capability Statements (ACS)* webpage.
You have acquired land for your generation asset.	This demonstrates project viability.
You have obtained consents, construction approvals, and licenses.	These regulatory approvals reduce the risk of legal challenges or delays during the commissioning.
You have completed financing arrangements and approvals.	This ensures you have the necessary funds to complete the project.
You have started construction or set and publicly communicated firm dates for construction.	This signals commitment and enables Transpower to anticipate and plan for future integration of the asset into the power system.
You know the connection topology (layout).	You must decide the point of connection before the initiation phase can begin. This assists the System Operator to evaluate potential system impacts and integrate your asset into the existing grid infrastructure.
You have reached a connection agreement with the Grid Owner or a Distributor.	This contract is essential for formalising the terms, conditions, technical specifications, responsibilities, timelines, and costs associated with connecting to the power system.

Once you have completed all prerequisites, fill out *the form* to proceed to the next phase. This will begin your formal engagement with the System Operator.

In addition to these prerequisites, we recommend you begin the following processes which are governed outside of the System Operator:

- coordinating protection with the Grid Owner or a Distributor, and
- developing your ICCP solution through Transpower's Customer Solutions team.

We recommend you indicate progress related to these two workstreams to us at the kick-off meeting (section 3.1 Attend the kick-off meeting).

The amount of time it takes to fulfil the feasibility milestones can vary significantly depending on the scale of your project, as signaled in the *Generation Connection Guide*. To commission generation, the System Operator recommends you have met all these requirements at least 12 months before you plan to connect your asset to the power system for the first time. This date is referred to as the 'planned commissioning date' and it signals the start of the commissioning phase. This ensures you will have adequate time to complete the activities in the commissioning phases that follow.

1.2 Existing Assets

For existing assets undertaking maintenance or upgrade work, there are two prerequisites:

Milestone	Why is this important?
You have started construction or set and publicly communicated firm dates for construction.	This signals commitment and enables Transpower to anticipate and plan for future integration of your upgraded asset into the power system.
You have submitted an early planning asset capability statement (ACS).	This helps the System Operator understand the upgraded technical capabilities and reassess the asset's potential impact on the power system.

Even though there are fewer prerequisites, you should still engage with the System Operator early – 12 months before your planned commissioning date. This time will help the System Operator to accurately assign resourcing to your project. Also, some asset upgrades or replacements might still require a significant amount of work to comply with the Code.

Fulfilling the System Operator's prerequisites takes collaborative effort. You should seek specialist advice and consult the documents on the *Commissioning Generation* webpage. If you have any questions after investigating your available knowledge sources, please contact the System Operator at *compliance@transpower.co.nz*.

Once you have completed all your prerequisites, fill out *the form* to proceed to the next phase.

2. Initiation

Feasibility | **Initiation** | Planning | Delivery | Commissioning | Closeout

Your completed form confirming you have met the feasibility prerequisites marks the start of the initiation phase and is your first formal interaction with the System Operator. Beginning this phase is effectively a signal that you have confirmed your design and have therefore laid the foundation for a successful project. This begins a sequence of activities within the System Operator so we can support you through the rest of the commissioning process. These activities include:

- reviewing your asset capability statement
- engaging internal stakeholders and allocating resourcing to your project
- scoping and preparing suitable guidance
- arranging a formal kick-off meeting with you.

The System Operator aims to complete the above activities and reach out to you within 10 business days of your confirmation email.

If the information provided is not satisfactory, we will collaborate with you to address any outstanding queries before the kick-off meeting.

Most of the work during the initiation phase happens within the System Operator, but we recommend you progress the activities that follow to prepare for the next phase.

2.1 Prepare documents for the kick-off meeting

Before the kick-off meeting, become familiar with our *DT-EA-1146 Code Commissioning Meeting Minutes Template*. We recommend you liaise with your stakeholders (for example, by hosting an internal kick-off meeting) and begin to fill out the template after reading through the rest of this document. Ensure that you brief any contractors involved with your project. We especially want you to have schedule your project's key milestones as listed in the template, essentially creating a draft timeline. You can make changes following further conversations with us, as we can provide feedback on the practicality of your dates.

Refer to Chapter 1 of *CACTIS* for clarity on the mandatory time frames.

Be aware that if the mandated time frames in CACTIS cannot be met, the planned commissioning date may need to be pushed back.

We also want you to request a three letter site code for your plant if this is your first time connecting to the power system. Each generating station in New Zealand that is required to communicate with the System Operator operationally has one. You can access the request form here: *FM-SD-547 Three Letter Site Code Request Form*.

This process might take several weeks depending on whether your suggested three letter code conflicts with *any existing codes* or the System Operator's guidelines, which can be found on the request form. We encourage you to consult local iwi affiliated with the site of your asset and arrive at a site name that is culturally appropriate and relevant. Although arriving at a site code is not a complex task, it needs to be confirmed early because it means that documents you will complete for compliance will have a consistent station name.

2.2 Consult the final compliance checksheet

The System Operator has prepared *CL-EA-1147 Final Compliance Checksheet* for you, listing the obligations that generally apply to commissioning assets. We recommend using it to as a reference point throughout the commissioning process (along with *the Code* and *CACTIS*), and to support you to demonstrate how you have met your obligations in the closeout phase. Returning to these documents regularly will make the final assessment in the closeout phase progress more smoothly.

3. Planning

Feasibility | Initiation | **Planning** | Delivery | Commissioning | Closeout

The planning phase involves you and the System Operator collaborating to set the commissioning project up for success. You will agree on timelines and prepare for all activities that occur in the delivery, commissioning, and closeout phases. Be mindful of these agreed times and work to abide by them, as even minor non-conformances early may result in significant delays of the planned commissioning date.

For an asset owner commissioning generation for the first time, the planning phase might take approximately 1 month, though this may vary depending on the complexity and scale of your project.

3.1 Attend the kick-off meeting

The kick-off meeting is the first opportunity for both asset owner and the System Operator to connect and agree on what is to come. We recommend you invite any contractors or consultants to this meeting who will have a key role in supporting you with your commissioning project – you should ensure they are briefed of your project's implications beforehand to keep the agenda focused. We will facilitate this meeting to provide those present with a clear understanding of the path ahead for successfully commissioning generation once connected to the power system.

The System Operator will reach out to arrange a suitable time for this meeting. It usually lasts 1 hour and takes place online (usually via Microsoft Teams). Once the meeting has occurred, you are responsible for familiarising any consultants and contractors who did not attend.

Find below the agenda for a typical kick-off meeting, along with a brief explanation of what to expect.

- **Welcome and introductions:** this is an opportunity for you to meet with the key people from the System Operator who will be supporting you throughout the process.
- **Roles and responsibilities:** this is to clarify what the System Operator expects from you, and what you can expect from us. There will be an emphasis on communication channels, single points of contact, and an escalation path for addressing concerns.
- **Project overview and timelines:** this is to review the project's scope, confirm key milestones and chart the roadmap to commissioning. It will be useful if you already have a sense of a timeline before this. We will introduce you to your Asset Owner Performance Obligations (AOPOs) and the long-lead items that apply to your asset. We will be using this information to update our market and power system tools to enable your connection.
- **Market considerations:** this is to discuss your market obligations, registration, and offer and dispatch procedures. We will also facilitate a discussion about ancillary services you may wish to offer.
- **Commissioning documents:** this is to discuss the documentation you must produce during the upcoming delivery phase, including the Code commissioning plan, connection studies, engineering methodology, and operational test plans. You will be able to ask questions and clarify submission deadlines.

Following the kick-off meeting, the System Operator expects you to organise and manage minutes of all future meetings. You will also record project decisions and risks raised throughout the upcoming phases of commissioning towards the end of the *DT-EA-1146 Code Commissioning Meeting Minutes Template*.

The rest of this section details the key planning activities from this phase. We have divided most of these activities into four key workstreams as illustrated in the table below. During the planning phase, these workstreams are only just beginning. However, it is useful to think about the requirements from these four perspectives as the workstreams can operate in parallel during the delivery phase, and at times connect to one another, in the lead-up to commissioning.

Workstream	Related Subsection
Code compliance documentation	3.2 Agree on a project plan 3.3 Update your planning stage ACS
Power system studies and modelling	3.4 Start work on long-lead items
Operational and market information	
Activities external to the System Operator	

3.2 Agree on a project plan

A project plan is the key deliverable of the planning phase. This is like a roadmap outlining all the necessary steps to take and when you expect to complete them.

You will have already begun on your project plan in the initiation phase, as key milestones are listed in our *DT-EA-1146 Code Commissioning Meeting Minutes Template*. Following kick-off, you can update this plan in consultation with the System Operator. When you are ready to submit it, email your agreed point of contact listed within the document.

You should begin updating your project plan shortly after the kick-off meeting and aim to submit it to the System Operator for feedback within 1 month.

3.3 Update your planning stage ACS

Over the course of the planning phase, you will scope and arrive at more detailed information about the capability of your asset. You must keep this statement up to date throughout the commissioning process. Any time you have updated information available, you should publish it using the Asset Capability Statement (ACS) tool in the *System Operator Customer Portal* to make it visible to the System Operator. The Lead System Operator Engineer will receive your updates and assess them. Submitting information earlier allows us time to review and provide feedback.

Refer to Chapter 1 of *CACTIS* for the applicable time frame requirement and Chapter 3 for details on what your ACS at this stage must include. If the System Operator requires more information, we will request it.

You should update your planning ACS before you submit your project plan, so within 1 month of the kick-off meeting.

You can find more information about completing your ACS on the *Asset Capability Statements (ACS)* webpage.

3.4 Start work on long-lead items

At the kick-off meeting, the System Operator will mention some items that you should plan for well in advance of your planned commissioning date. This is often because these long-lead items are complex and will require significant effort. They sometimes involve stakeholders other than the System Operator, such as your equipment manufacturers and the Grid Owner or a Distributor, whichever you are connecting to. We advise you to start on these long-lead items early, even if some of them are expected to take less than 6 months.

To reiterate, you will not complete these long-lead items before the end of the planning phase, but you must complete them all before your planned commissioning date. We have divided these items based on the main activity workstreams in the delivery phase. Find all these items below, along with brief explanations of what is involved in each.

3.4.1 Power system studies and modelling

The System Operator requires all assets to be properly represented in our systems through modelling. Before commissioning, we need you to create and test certain models so that we can assess your asset's impact on the power system and support its safe and reliable operation. The long-lead items related to modelling are:

- **Connection studies:** you need to scope and plan certain technical analyses to assess the impact of your new generation on the power system. These analyses ensure you can meet your performance obligations. By completing these studies, you will confirm the suitability of your equipment design and connection location. Refer to *GL-EA-953 Connection Study Requirements* for specific details on these, including any relevant model requirements. You might also find our *Power System Studies and Modelling* webpage useful. If you have not already started scoping connection studies prior to the planning phase, you must do so now.

Refer to Chapters 4 and 5 of CACTIS for modelling requirements and the details of what your connection studies must consider.

These studies involve coordination between you and the System Operator and can take between 6 and 12 months.

- **Power system models:** the System Operator needs to understand your asset's internal workings and control logic so that we can complete network simulations. To this end, you must provide us with power system models in software packages compatible with our simulation tools. For some of these models, your original equipment manufacturer may need to discuss confidentiality with the System Operator directly. Refer to our *GL-EA-716* (for synchronous assets) and *GL-EA-1311* (for inverter-based resources) documents for specific details.

Refer to Chapter 4 of *CACTIS* for the criteria that your connection study models must meet.

Developing these models can take 1-3 months, but discussions regarding model confidentiality can sometimes last longer.

3.4.2 Operational and market information

The System Operator requires reliable communication channels between generating assets and the National Coordination Centre. This communication enables real-time monitoring, control, and dispatch. As mentioned in the feasibility section, this workstream is governed outside of the System Operator, though it involves certain teams within the System Operator once your solution is underway. Refer to Workstream B in the *Generation Connection Guide* for an overview of the process. The long-lead items for this workstream are:

- **ICCP infrastructure and SCADA connection:** if your asset is required to provide operational communications, you must have a robust Supervisory Control and Data Acquisition (SCADA) system to monitor and exchange real-time indications and measurements with the System Operator's own SCADA system. This essential communication involves using Inter-Control Centre Communications Protocol (ICCP) which first needs to be set up and tested. Learn more about this by reviewing Transpower's *Operational Data Integration* webpage, and by contacting our Customer Solutions team at *customer.solutions@transpower.co.nz*.

- **Dispatch communications:** to fully participate in the electricity market, you must have the ability to receive and acknowledge dispatch instructions from the System Operator. For this purpose, you may use either ICCP or Web Services. You can find more information about our dispatch service requirements on the *About Generation Offers and Dispatch* webpage. If you have an existing dispatch system, you should contact the Market Operations team at *market.operations@transpower.co.nz* to discuss using it for any additional asset(s).

Refer to Chapter 8 of *CACTIS* for detailed operational communications requirements.

Setting up the new ICCP infrastructure for an asset can take up to 12 months, whereas it can take 3-6 months if your solution involves using existing communications infrastructure.

- **Ancillary services:** the System Operator procures ancillary services to support the reliable operation of the power system. Your asset may provide one or more of these services, and to offer any of them, you must enter separate contracts with the System Operator. You must then demonstrate your asset's capability through testing and modelling. If you plan to do this testing in parallel with generation commissioning, you should identify the services you want to offer early so that you can include them in your Code commissioning documents during the Delivery phase. Visit the *Ancillary Services* webpage for more information.

Consult the *Procurement Plan* to understand the contractual terms and technical requirements that apply to each service.

You should factor about 12 months for the process of modelling, testing, contracting and finally offering certain ancillary services such as Instantaneous Reserves. Read more about this particular service on the *Instantaneous reserve* webpage. Some services take less time than this.

Note for BESS (battery energy storage systems) and load asset owners – In addition to the ancillary services above, you might also participate in the wholesale electricity market on the demand side. You can find out more by visiting the *Demand side participation* webpage. If you have questions, reach out to the Market Operations team at *market.operations@transpower.co.nz*.

If you are an asset owner wishing to offer Instantaneous reserve, you will need to notify the Market Operations team at *market.operations@transpower.co.nz* as early as possible if offering reserves for the first time or modifying existing reserves. We require the validated power system model of your asset which will be converted for use in Transpower's Reserve Management Tool. Note that the Reserve Management Tool model may need to be audited externally before it can be put into production, which will take at least 3 months.

3.4.3 Activities external to the System Operator

There are key activities that you must engage in outside your collaboration with the System Operator. We note these long-lead items below as reminders to you because we do not have oversight of them and some may impact your connection to the power system – or your ability to make revenue. This means commissioning process tasks will stop if certain milestones are not met, resulting in delays to the planned commissioning date.

- **Protection coordination at the grid interface:** the protection systems on both sides of a grid interface must remain coordinated after your asset connects to the power system. The System Operator requires written assurance of such coordination *before* your asset is connected. As signalled in the feasibility section, you will

need to proactively engage with the parties at the grid interface to seek out this coordination, and then present it to us. We recommend you review the protection assessment guidelines *here*.

This activity can take up to 12 months due to the complexity of coordinating protection settings across multiple assets and stakeholders. You might also need to carry out protection studies.

- **Metering design:** you must design and install metering infrastructure that meets industry standards and guidelines and Code requirements where applicable. The equipment would measure your asset's output and consumption.

Although this process could take up to 3 months, changes to the design can further extend the time. It is best to get this settled earlier rather than later. Contact either the Grid Owner or Distributor – whichever you are connecting to – for further requirements.

- **Outage and switching requests:** commissioning may require planned outages or switching of other asset owners' equipment to connect your asset to the power system.

This process can take up to 13 weeks depending on the complexity of your requests. However, some outages may be unavailable during certain periods of the year depending on where the connection is, so we have included this activity here because it is a long-lead item for certain assets. Contact the Grid Owner or Distributor – whichever you are connecting to – for further clarification about your specific situation.

4. Delivery

Feasibility | Initiation | Planning | **Delivery** | Commissioning | Closeout

The delivery phase begins once you and the System Operator agree on your project plan. This is the longest phase of the commissioning process as it requires you to coordinate with stakeholders and fulfil all the requirements agreed so far. The long-lead items outlined in section 3.4 above must also be completed before the commissioning phase can begin.

Refer to Chapter 1 of *CACTIS* for a list of all the time frame requirements before commissioning. Note that all the deadlines are for final copies (as defined in the CACTIS); your timings should take into account drafting and review interactions before final submissions.

The delivery phase leads right up to the moment your generation asset is ready to connect to the power system and start commissioning. This phase takes approximately 10 months, depending on the complexity of the project. If you are scheduling activities that would lead Transpower to make changes to its tools, such as SCADA or Reserve Management Tool, then you should be aware that no changes are made to those between mid-December and mid-January.

To support you through this phase, we remind you that you must:

- consult with *the Code* and our guideline documents and templates linked to each activity
- adhere to the schedule agreed to in the project plan
- follow the agreed communication paths
- communicate with the System Operator early if you anticipate risks, delays or any other issues
- be mindful of your points of contact and escalation path within the System Operator's team.

This section of the document briefly explains the activities you will undertake to reach your planned commissioning date. As mentioned in the planning phase section, we have consolidated these activities into four workstreams to support your understanding. Find the workstreams below, along with the subsections where you can find the corresponding activities:

Workstream	Related Section
Code compliance documentation	*4.1.1* – 4.1.4
Power system studies and modelling	*4.2.1* – 4.2.2
Operational and market information	*4.3.1* – 4.3.4
Activities external to the System Operator	*4.4.1*

4.1 Code compliance documentation

4.1.1 Develop a Code commissioning plan

The Code commissioning plan is a formal document that outlines the 'what' of commissioning. It includes the activities you will carry out to meet your Code obligations during the commissioning of your asset.

Our structured *DT-EA-338 Code Commissioning Plan Template* contains instructions and examples which will guide you to provide the information to meet your obligations.

Refer to Chapter 1 of *CACTIS* for the applicable time frame and Chapter 2 for the specific requirements that your Code commissioning plan must fulfil.

You will have already started working on the various elements of the Code commissioning plan during the planning phase. Coordinating all the items together into a robust plan may take 6 months. We recommend you submit a draft at least 4 months before the planned commissioning date as the System Operator needs a minimum of 4 weeks to review it and provide feedback, which you must then implement into a final copy.

4.1.2 Develop an engineering methodology

The engineering methodology captures the 'how' of commissioning. You must prepare a document with a comprehensive technical description of all engineering tests you will conduct, the expected results, and data to be collected and shared with the System Operator. These requirements are captured in the *GL-EA-010 Generator Testing Requirements* document. Use our *DT-EA-1337 Engineering Methodology Template* to structure your information.

Refer to Chapter 1 of *CACTIS* for the applicable time frame and Chapter 7 for the specific details that your engineering methodology must contain.

You will start on this engineering methodology document in the first few weeks after we agree with you on a project plan. Continue to make contributions to the methodology as you develop the test scripts. The System Operator expects a draft engineering methodology within 1 month of when you submit your first Code commissioning plan draft – allow 4 weeks so we can review and provide feedback towards your final copy.

4.1.3 Update to a pre-commissioning stage ACS

During the delivery phase, we expect you to complete all fields of your ACS, unless there is a valid reason not to. Note that the information you submit does not have to include final values or drawings.

Refer to Chapter 1 of *CACTIS* for the applicable time frame and Chapter 3 for specific requirements concerning your ACS at this stage.

You will update your ACS several times during the delivery phase. We recommend you do so as soon as the information becomes available.

As a reminder, you can find more information and resources to support you with completing your ACS on the *Asset Capability Statements (ACS)* webpage.

4.1.4 Submit operational test plans

Operational test plans indicate the 'when' of commissioning. The test plan template to use is *FM-EA-010 Test Plan*. They are formal documents that provide an overview of testing for our power system coordinators. They include details like risks, impact to the power system, timing, and relief from performance obligations. During each test, you must strictly follow all conditions outlined in the relevant agreed-upon operational test plan. The System Operator has general information available on the *Asset Testing* webpage.

Refer to Chapter 1 of *CACTIS* for the applicable time frame and Chapter 6 for specific requirements of what your test plan must include.

You should submit operational test plans as early as possible before the date of each test. For planned tests, at least 3 weeks' notice must be given via the template linked above.

4.2 Power system studies and modelling

4.2.1 Submit a connection studies report

You will have scoped and planned connection studies before or during the planning phase. During the delivery phase, you must complete these studies to assess factors like voltage stability, fault ride-through capability, frequency and voltage regulation, as outlined in our *GL-EA-953 Connection Study Requirements* guideline. The System Operator expects you to collate your findings into a comprehensive report and provide adjoining model case files.

Refer to Chapter 1 of *CACTIS* for the applicable time frame and Chapter 5 for details on what your connection studies must consider.

We recommend you submit a first draft of your connection studies report and the model case files at least 6 months before the planned commissioning date. Following this first draft, we will provide feedback and seek clarifications if necessary. Depending on the complexity of these interactions, this could take a few months.

4.2.2 Prepare power system models for validation

Following on from the long-lead item mentioned in the planning phase, you must provide the System Operator with models to support your connection studies. They should illustrate your asset's expected behaviour under a range of operating conditions. Refer to our *Power System Studies and Modelling* webpage and our *GL-EA-716* (for synchronous assets) and *GL-EA-1311* (for inverter-based resources) documents for more specific guidance. You will validate these models in the closeout phase.

Refer to Chapter 1 of *CACTIS* for the applicable time frame and Chapter 4 for the criteria that your connection study models must meet.

Developing these models can take 1-3 months, so if you did not start doing this in the planning phase, you should do so during delivery. As with compliance documentation, you should submit a draft a few months the final copy deadline to allow for System Operator feedback.

4.3 Operational and market information

4.3.1 Prepare and submit final ICCP datasets

As part of the Operational Data Integration workstream in the *Generation Connection Guide*, you must prepare two important datasets as part of your data transmission contract:

- a set of indications and measurements to ensure compliance with the Code and the safe operation of your asset, and

- a set of proposed dispatch tags to ensure you can receive and acknowledge dispatch instructions.

The datasets must be collated and submitted in one spreadsheet. This activity is coordinated by the Customer Solutions team, reachable at *customer.solutions@transpower.co.nz*.

Refer to Chapter 1 of *CACTIS* for the applicable time frame and Chapter 8 for detailed operational communications requirements.

Allow time for reviews of your dataset as various teams within Transpower are involved in the process. Contact *compliance@transpower.co.nz* if you have questions about the suitability of your indications and measurements dataset, or *market.operations@transpower.co.nz* if you require guidance related to the dispatch tags.

4.3.2 Finalise dispatch communications

The New Zealand electricity market uses WITS (Wholesale Information Trading System) as the platform for market interactions. Review Workstreams B and C the *Generation Connection Guide* for more detail about your offer obligations and the procedures involved. One key requirement for submitting offers and receiving dispatch instructions is to have robust dispatch systems set up, for which you may use ICCP or Web Services, as mentioned in the planning phase.

We require your dispatch systems to be tested thoroughly before commissioning. This might include designing and building new systems, upgrading equipment, and training staff in the use and management of dispatch facilities. Contact the Market Operations team for more details at *market.operations@transpower.co.nz*. They can also assist with guiding documents and recommendations.

Refer to Chapter 1 of *CACTIS* for the applicable time frame.

The System Operator needs 3-6 months before the planned commissioning date to test and approve your dispatch system. While you can complete some of this activity at the same time as 4.3.1, we recommend you factor in an extra 2 months to test your dispatch software with us.

4.3.3 Complete ancillary services preparation

Following on from the long-lead item in the planning phase, if you have decided that you want to offer ancillary services through your asset, you must understand all your obligations and demonstrate your asset's capabilities to provide those services. Once you demonstrate your ability to meet the Procurement Plan and any contractual terms and conditions, we may enter a contract with you to offer that ancillary service. See the *About ancillary services* webpage for additional information.

You should factor several months for the modelling, testing, contracting and finally offering certain ancillary services such as Instantaneous Reserves: *Instantaneous reserve*. Not all services take this long to process.

You can include necessary preparations to demonstrate ancillary services in your Code commissioning documents. This would allow your Code and Procurement Plan testing to be carried out together. If, for any reason, this is not possible, then you can undertake the testing to demonstrate your asset's capability of offering ancillary services after the end of the commissioning phase. For this purpose, you would use an operational test plan: *FM-EA-010 Test Plan.*

4.3.4 Submit final notices

In the lead-up to commissioning, you will need to notify us before making an offer for the first time, and to provide information we require for scheduling and dispatch. There are two forms to complete – find them linked below.

FM-EA-008 Generator Notice of Initial Offer: you should submit this to the Market Operations team 4 months before your planned commissioning date to allow us to set up the market system so you can trade. Submit a digital copy to *market.operations@transpower.co.nz*.

FM-EA-006 Notice of Intention to Connect: you should submit this to both the lead System Operator engineer assigned to your project and to *compliance@transpower.co.nz* at least 5 days before your planned commissioning date.

4.4 Activities external to the System Operator

4.4.1 Advise protection coordination has been confirmed at grid interface

This long-lead item, flagged earlier in this document, is a show-stopper – **it must be completed before commissioning**. Both parties at the grid interface must provide the System Operator with written confirmation that protection is coordinated. See the appendix of the *Grid Owner's protection assessment guide* for an example. It is your responsibility to ensure this occurs.

Refer to Chapter 1 of *CACTIS* for the applicable time frame.

Start as early as possible and engage the stakeholders involved in a proactive manner.

5. Commissioning

Feasibility | Initiation | Planning | Delivery | **Commissioning** | Closeout

The commissioning phase is where all the hard work from the previous phases pays off. Your asset transitions from construction to integration with the power system. The tests carried out during this phase will demonstrate your asset's performance, capability and compliance with the Code – in other words, your AOPOs. The System Operator's responsibility during this time is to assess test results and risks.

During this phase, you must comply with the Code commissioning plan, engineering methodology, and operational test plans. Failure to do so may result in delays and potential breaches of the Code. Additionally, you should communicate promptly with regarding any non-compliances you identify.

The commissioning phase typically lasts as long as you need to fully test your equipment to demonstrate compliance with the Code. During this period, the new asset can connect to the power system for the purpose of testing only. All works in this phase must comply with the agreed Code commissioning plan.

To meet the time frame requirements after the commissioning phase, we advise that you arrange for your modelling consultant(s) to be on site during commissioning tests. This would allow them an opportunity to screen-test data and validate (at least at a high level) your asset model against that data. Their presence will help make the process more efficient, especially if you need to repeat some of the testing.

Once both you and the System Operator agree that commissioning is complete, you can operate your asset without the need to submit *operational test plans*. We will then progress to closeout phase.

Note: in addition to any submitted operational test plans during commissioning, the System Operator may request you to complete and submit a day-ahead schedule. This would be a spreadsheet with MW and MVAr charted against time for each coming day's commissioning activities.

6. Closeout

Feasibility | Initiation | Planning | Delivery | Commissioning | **Closeout**

The closeout phase is the formal completion of the generation commissioning process. The primary activity of this phase centres on documenting your asset's performance and ensuring you have met all Code requirements. During this phase, your relationship with us shifts from being testing-oriented to one focused on operational compliance and coordination.

Refer to Chapter 1 of *CACTIS* for the applicable time frame requirements after commissioning.

We expect the closeout phase to take 1-4 months from the end of the commissioning period, depending on the complexities that may arise during model validation and compliance assessments.

Ongoing during this final phase, you must manage any newly identified non-compliances with AOPOs and technical codes. The System Operator will only allow your asset to transition to normal commercial operation if you remain responsible for these.

To demonstrate final compliance with all your Code obligations, you must complete the following activities:

Requirement	Reference
1. Submit a final stage ACS	CACTIS Chapter 3
2. Submit final test reports and data	CACTIS Chapter 7
3. Submit validated models and modelling report	CACTIS Chapter 4
4. Gather and submit evidence that you have complied with the Code	*CL-EA-1147 Final Compliance Checksheet*

When conducting the final assessment, the System Operator assesses your asset's compliance against the Code clauses, including those in the CACTIS. If any clauses are not met, they will be managed as exceptions until met. Therefore, if we raise any findings or recommendations, you will need to address these. This might involve minor modifications, control system tuning, or creating additional documentation.

Once we are satisfied with the final assessment of your asset, the commissioning process is complete. Congratulations!

7. Appendix

7.1 Glossary of Acronyms and Initialisms

Acronym or Initialism	Meaning
ACS	Asset Capability Statement
AOPO	Asset Owner Performance Obligation
CACTIS	Connected Asset Commissioning, Testing and Information Standard
EIPC	Electricity Industry Compliance Code 2010; referred to as 'the Code'
NDA	Non-Disclosure Agreement
SCADA	Supervisory Control and Data Acquisition
WITS	Wholesale Information Trading System

8. Document Information

8.1 Copyright Information

8.2 Metadata

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