Deliverability is an essential element of any resource adequacy requirement. Specifically, Load Serving Entities (LSEs) must be able to show that the supplies they intend to procure to meet their load requirements can be delivered to load when needed. Otherwise, such resources are of little, if any, value for the purposes of resource adequacy.

An effective deliverability assessment is essential in resource plans so that the LSEs will be able to “count” their resources to determine whether they satisfy the Commission’s planning reserve margin. Draft 1 of this paper was the focus of a six-hour meeting and a two-hour conference call involving approximately 30 participants, as well as written comments from eight participants as of April 5th, 2004. The current version of this paper is the result of much stakeholder discussion.

The complete deliverability proposal consists of three assessments: Deliverability of Generation to the Aggregate of Load, Deliverability of Imports, and Deliverability to Load Within Transmission Constrained Areas. Each of these tests would be required for the overall deliverability methodology to ensure that resources procured by LSE’s would be deliverable to load. CPUC Decision 04-10-035, requested that the CAISO serve an updated description of the proposed generation and import deliverability to the aggregate of load (Baseline) study methodology, its data requirements, and a schedule for the analysis. Therefore, this paper focuses on the Deliverability of Generation and Imports to the Aggregate of Load portions of the methodology. An implementation of only the generation and import deliverability tests would be an incomplete implementation of the deliverability methodology, and would not adequately ensure deliverability of resources to load.

A. Deliverability Of Generation To The Aggregate Of Load

As part of developing its proposal to comply with FERC’s Order No. 2003 regarding the interconnection of new generating facilities, the ISO developed and proposed to FERC a “deliverability” test (but not a requirement). The purpose was to begin to assess the deliverability of new generation to serve load on the ISO’s system. Recent experience indicates that while California has added needed new generating capacity to the system over the past few years, not all of that capacity is deliverable to load on the system because of the presence of transmission constraints. Therefore, although not requiring all new generation to be deliverable, the ISO proposed in its Order 2003 compliance filing to assess deliverability so that the sponsors of new generation projects can accurately assess their ability to deliver the output of the new plants to the aggregate of load for resource adequacy counting purposes. This first assessment reflects the deliverability test and the baseline analysis envisioned by the ISO to be conducted as part of this interconnection process.
Appendix 1  PRELIMINARY DELIVERABILITY BASELINE ANALYSIS STUDY REPORT

The ISO recommends that a generating facility deliverability assessment be performed to determine the generating facility’s ability to deliver its energy to load on the ISO Controlled Grid under peak load conditions. Such a deliverability assessment will provide necessary information regarding the level of deliverability of such resources with and without Network Upgrades (i.e., major transmission facilities), and thus provide information regarding the required Network Upgrades to enable the generating facility to deliver its full output to load on the ISO Controlled Grid based on specified study assumptions. That is, a generating facility’s interconnection should be studied with the ISO Controlled Grid at peak load, under a variety of severely stressed conditions to determine whether, with the generating facility at full output, the aggregate of generation in the local area can be delivered to the aggregate of load on the ISO Controlled Grid, consistent with the ISO’s reliability criteria and procedures. (This definition for deliverability comes from the FERC interconnection order, and this methodology for assessing deliverability has been developed from consultation with PJM officials about their already-established practices.)

In addition, the ISO recommends, based on guidance in FERC Order 2003, that the deliverability of a new resource should be assessed on the same basis as all other existing resources interconnected to the ISO Controlled Grid.

Because a deliverability assessment will focus on the deliverability of generation capacity when the need for capacity is the greatest (i.e., peak load conditions), it will not ensure that a particular generation facility will not experience congestion during other operating periods. Therefore, other information (i.e., congestion cost analysis for all hours of the year) would be required in addition to the deliverability assessment to evaluate the congestion cost risk of energy purchase agreements, such as a take-or-pay contract with a particular generation facility.

Section I, Generator Deliverability Assessment, contains the technical details of this proposed methodology.

B. Deliverability of Imports

California is now, and will likely remain, dependent on imports to satisfy its energy and resource requirements. Therefore, it is likely that as part of fulfilling their obligation to procure sufficient resources (reserves) in the forward market to serve their respective loads, the IOUs will contract with out-of-state resources. This is appropriate and necessary.

The ability to rely on imports to satisfy reserve requirements is entirely dependent on the deliverability of such out-of-state resources to and from the intertie points between the ISO’s system and the neighboring systems. While the existing system may be able to satisfy the procurement plans of any one LSE, it likely will not be able to transmit the sum of LSEs’ needs. Each LSE may well plan to rely on the same potentially constrained...
transmission paths to deliver their out-of-state resources. Therefore, the transmission system should be checked to make sure that simultaneous imports can be accommodated.

When relying on imports to serve load, each LSE should be required to ensure that they have assessed the deliverability of such resources from the tie point to load on the ISO’s system.

At the CPUC's April 12-13, 2004 Deliverability Workshop, an action item was assigned to the California ISO. As requested, the ISO coordinated a detailed technical discussion and development of a proposal for establishing the total import capacity, for each import path, to be allocated to Load Serving Entities (LSEs) for resource adequacy planning purposes. This proposed approach was presented at the Deliverability Workshop on May 5, 2004.

Transmission constraints can impact the simultaneous deliverability of imports and internal generation. As a result, the interaction between the deliverability of imports and the deliverability of generation needs to be examined. The proposed generation deliverability assessment includes, as an input assumption, the amount of imports and existing transmission contract related encumbrances electrically flowing over the ISO Controlled Grid.

Whatever import capacity is available to LSEs for resource adequacy planning purposes should also be the basis for the import assumptions in the internal generation deliverability analysis. Workshop participants proposed that historical import information should be the basis for determining the initial amount of import levels to be allocated to LSEs. In addition to using historical data, existing transmission contract (ETCs) information should also be utilized. It is assumed that the entities that have contracted for the transmission capacity are already relying on this import capability in their resource plans, so this transmission should not be reallocated.

The impact of these total import levels would likely affect the deliverability of some existing generation, and the interplay between the deliverability of these existing generators and imports needs to be addressed during the generation deliverability analysis. If the deliverability analysis determines that the initial import level assumption is reducing the deliverability of internal ISO grid generation, then the initial import levels would be reduced and the deliverability analysis would be re-run. Although it is not anticipated that import levels would have to be reduced significantly from their initial level based on historical data, this issue may need to be reassessed after the analysis is completed. One of the key benefits of this proposed approach is that a clear deliverability benchmark would be established up front, it would be the starting point for future years, and LSEs would have some flexibility within this structure to adjust their resource adequacy plans to find an appropriate balance between imports and existing generation inside California.
Section II, Deliverability of Imports Assessment, contains the technical details of the deliverability of imports study methodology developed by the subgroup.

D. Summary

Several entities reviewing the “Strawperson” proposal questioned how the ISO might tie together these three suggested “buckets” of Deliverability, and when individual resources might be determined or categorized as “deliverable” based on these proposed tests.

The Generation Deliverability Assessment would be performed in the annual baseline analysis and in every new System Impact Study as part of the generation interconnection process. Resources that pass the deliverability assessment could be counted to meet reserve margin requirements and resources that don’t pass could not.

Total import capacity to be allocated for resource adequacy purposes would be an input to the generation deliverability assessments. The deliverability of the total import capacity would be assessed during the initial and annual baseline analyses. LSE’s could propose additional imports in their long-term resource plans beyond the amounts allocated and these additional imports would tested using the generator deliverability methodology to ensure that the additional imports do not impact the deliverability of generation that has already passed the generation deliverability test. Once the resource plans are approved, the import assumptions for future generation deliverability assessment would be updated as needed.

The Deliverability to Load test would be performed so that the results would be available during the development of the long term resource plans. Solutions for resolving resource deficient load pockets could include the construction of resources needed to meet reserve margin requirements but located in the deficient load pocket to mitigate the deliverability to load deficiency. The construction of resources within the load pocket could be by any developer of generation—a procurement contract with that new generator should ensure that it is actually built.
Section I
Generator Deliverability Assessment

1.0 Introduction

A generator deliverability test is applied to ensure that capacity is not "bottled" from a resource adequacy perspective. This would require that each electrical area be able to accommodate the full output of all of its capacity resources and export, at a minimum, whatever power is not consumed by local loads during periods of peak system load.

Export capabilities at lower load levels can affect the economics of both the system and area generation, but generally they do not affect resource adequacy. Therefore, export capabilities at lower system load levels are not assessed in this deliverability test procedure.

Deliverability, from the perspective of individual generator resources, ensures that, under normal transmission system conditions, if capacity resources are available and called on, their ability to provide energy to the system at peak load will not be limited by the dispatch of other capacity resources in the vicinity. This test does not guarantee that a given resource will be chosen to produce energy at any given system load condition. Rather, its purpose is to demonstrate that the installed capacity in any electrical area can be run simultaneously, at peak load, and that the excess energy above load in that electrical area can be exported to the remainder of the control area, subject to contingency testing.

In short, the test ensures that bottled capacity conditions will not exist at peak load, limiting the availability and usefulness of capacity resources for meeting resource adequacy requirements.

In actual operating conditions energy-only resources may displace capacity resources in the economic dispatch that serves load. This test would demonstrate that the existing and proposed certified capacity in any given electrical area could simultaneously deliver full energy output to the control area.

The electrical regions, from which generation must be deliverable, range from individual buses to all of the generation in the vicinity of the generator under study. The premise of the test is that all capacity in the vicinity of the generator under study is required, hence the remainder of the system is experiencing a significant reduction in available capacity. However, since localized capacity deficiencies should be tested when evaluating deliverability from the load perspective, the dispatch pattern in the remainder of the system is appropriately distributed as proposed in Table 1.

Failure of the generator deliverability test when evaluating a new resource in the System Impact Study brings about the following possible consequences. If the addition of the resource will cause a deliverability deficiency then the resource should not be fully counted towards resource adequacy reserve requirements until transmission system upgrades are completed to correct the deficiency.
A generator that meets this deliverability test may still experience substantial congestion in the local area. To adequately analyze the potential for congestion, various stressed conditions (i.e., besides the system peak load conditions) will be studied as part of the overall System Impact Study for the new generation project. Depending on the results of these other studies, a new generator may wish to fund transmission reinforcements beyond those needed to pass the deliverability test to further mitigate potential congestion—or relocate to a less congested location.

The procedure proposed for testing generator deliverability follows.

## 2.0 Study Objectives

The goal of the proposed ISO Generator deliverability study methodology is to determine if the aggregate of generators in a given area can be simultaneously transferred to the remainder of ISO Control Area. Any generators requesting interconnection to the ISO Controlled Grid will be analyzed for “deliverability” in order to establish the amount of deliverable capacity to be associated with the resource.

The ISO deliverability test methodology is designed to ensure that facility enhancements and cost responsibilities can be identified in a fair and nondiscriminatory manner.

## 3.0 Baseline analysis

**Deliverability Test Validation:** This procedure was derived from the deliverability test procedure currently used by PJM. Adaptations to the PJM procedure were necessary due to the considerable physical differences between the PJM system and the ISO-Controlled Grid. During the initial implementation of this procedure, it will be tested, and evaluated on existing resources to ensure that the results are reasonable, equitable, and consistent with engineering judgment. Stakeholders will review the results of this validation process. The deliverability test procedure will be refined as needed.

In order to ensure that existing resources can pass this deliverability assessment, an annual baseline analysis, with the most up-to-date system parameters, must first be performed by applying the same methodology described below on the existing transmission system and existing resources. Identified deliverability problems associated with generation that exist prior to the implementation of this deliverability test may be mitigated by transmission expansion projects if the capacity is needed and/or the project is economically justifiable. Deliverability limitations on currently existing generation can be allocated among multiple generators contributing to the same problem by first giving a lower priority to generation that elected to not finance transmission upgrades identified in their interconnection study for deliverability purposes. Then, for units with the same priority, allocation of deliverability limitations would be based on the incremental flow impact that each generator would contribute to the problem. The deliverability of both existing and new generators that are certified as deliverable would be maintained by the annual baseline analysis and the transmission expansion planning process.
4.0 General Procedures and Assumptions

**Step 1:** Build an initial powerflow base case modeling ISO resources as shown in Table 1. This base case will be used for two purposes: (1) it will be analyzed using a DC transfer capability/contingency analysis tool to screen for potential deliverability problems, (2) it will be used to verify the problems identified during the screening test, using an AC power flow analysis tool. All new generation applicants in the interconnection queue ahead of the unit under study are set at 0 MW but available to be turned on during the analysis. Unused Existing Transmission Contracts (ETC’s) crossing control area boundaries will also be modeled as zero MW injections at the tie point, but available to be turned on at remaining contract amounts for screening analysis. Then the capacity resource units in the queue electrically closest to the unit being studied are turned on at an equivalent level to the existing capacity resource until the net ISO Control Area interchange equals the interchange target (see deliverability of imports section). Generation applicants after the queue position under study are not modeled in the analysis.

**Step 2:** Using the screening tool, the ISO transmission system is essentially analyzed facility by facility to determine if normal or contingency overloads can occur. For each analyzed facility, an electrical circle is drawn which includes all units (including unused ETC injections) that have 5% or greater distribution factor (DFAX) on the facility being analyzed. Then load flow simulations are performed, which study the worst-case combination of generator output within each 5% DFAX circle. The 5% DFAX circle can also be referred to as the Study Area for the particular facility being analyzed.

**Step 3:** Using an AC power flow analysis tool and post processing software, verify and refine the analysis of the overload scenarios identified in the screening analysis.

The outputs of capacity units in the 5% circle are increased starting with units with the largest impact on the transmission facility. No more than twenty units are increased to their maximum output. In addition, no more than 1500 MW of generation is increased. All remaining generation within the Control Area is proportionally displaced, to maintain a load and resource balance. The number of units to be increased within a local area is limited because the likelihood of all of the units within a local area being available at the same time becomes smaller as the number of units in the local area increases. The amount of generation increased also needs to be limited because decreasing the remaining generation can cause problems that are more closely related to a deficiency in local generation rather than a generation deliverability problem.

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1 For the initial baseline analysis the interchange target is based on historical usage. The East of River upgrades are expected to increase the Palo Verde Branch Group by 500 MW. This 500 MW expected increase in scheduling capability was modeled similar to the Unused Existing Transmission Contracts.

2 The cumulative availability of twenty units with a 7.5% forced outage rate would be 21%--the ISO proposes that this is a reasonable cutoff that should be consistently applied in the analysis of large study areas with more than 20 units. Hydro units that are operated on a coordinated basis because of the hydrological dependencies should be moved together, even if some of the units are outside the study area, and could result in moving more than 20 units.
For Study Areas where the 20 units with the highest impact on the facility can be increased more than 1500 MW, the impact of the remaining amount of generation to be increased will be considered using a Facility Loading Adder. The Facility Loading Adder is calculated by taking the remaining MW amount available from the 20 units with the highest impact times the DFAX for each unit. An equivalent MW amount of generation with negative DFAXs will also be included in the Facility Loading Adder, up to 20 units. Negative Facility Loading Adders should be set to zero.

**Step 4:** Verified overloaded facilities with a DFAX from the new unit greater than 5% would need to be mitigated for the new unit to pass the deliverability test.
# Table 1: Resource Dispatch Assumptions

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Base Case Dispatch</th>
<th>Available to Selectively Increase Output for Stressed-Scenario Dispatch?</th>
<th>Available to Scale Down Output Proportionally with all Control Area Capacity Resources?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified Capacity Resources*</td>
<td>80% to 95% of Summer Peak Net Dependable Capacity</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Energy Resources*</td>
<td>Minimum commitment and dispatch to balance load and maintain expected imports</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Intermittent Resources</td>
<td>Minimum production during summer peak load hours</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Imports</td>
<td>As determined in deliverability of imports section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Non-pump load</td>
<td>90% to 100% of maximum load.</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>• Pump load</td>
<td>Within expected range for Summer peak load hours**.</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

* The initial baseline analysis would identify the initial set of Certified Capacity Resources and Energy Resources. See section 3.0 Baseline analysis. All units should be dispatched at the same percentage of their Net Dependable Capacity, but his level may fluctuate to account for differing expectations of system-wide forced outages, retirements, and spinning reserve levels. Some large units with a high likelihood of retirement within the near future may be dispatched at zero to balance loads and resources, but will be available to be turned on during the analysis.

** Summer peak load hours are the 50 to 100 hours in the months of August and September when Control Area load is between 90% and 100% of maximum annual load.
Appendix 1  PRELIMINARY DELIVERABILITY BASELINE ANALYSIS STUDY REPORT

Distribution Factor (DFAX)
Percentage of a particular generation unit’s incremental increase in output that flows on a particular transmission line or transformer when the displaced generation is spread proportionally, across all dispatched resources “available to scale down output proportionally with all control area capacity resources in the Control Area”, shown in Table 1. Generation units are scaled down in proportion to the dispatch level of the unit.

G-1 Sensitivity
A single generator may be modeled off-line entirely to represent a forced outage of that unit. This is consistent with the ISO Grid Planning Standards that analyze a single transmission circuit outage with one generator already out of service and system adjusted as a NERC level B contingency. System adjustments could include increasing generation outside the study area. The number of generators increased outside the study area should not exceed the number of generators increased inside the study area.

Municipal Units
Treat like all other Capacity Resources unless existing system analysis identifies problems.

Energy Resources
If it is necessary to dispatch Energy Resources to balance load and maintain expected import levels, these units should not contribute to any facility overloads with a DFAX of greater than 5%. Energy Resource units should also not mitigate any overloads with a DFAX of greater than 5%.

WECC Path Ratings
All WECC Path ratings (e.g. Path 15 and Path 26) must be observed during the deliverability test.

Pmax* DFAX Impact
Generators that have a (DFAX*Generation Capacity) > 5% of applicable facility rating or OTC will also be included in the Study Area.
Section II
Deliverability of Imports Assessment

Background

At the CPUC’s April 12-13, 2004 Deliverability Workshop, an action item was assigned to the California ISO. As requested, the ISO coordinated a detailed technical discussion and development of a proposal for establishing the total import capacity, for each import path, to be allocated to Load Serving Entities (LSEs) for resource adequacy planning purposes. This proposed approach was presented at the Deliverability Workshop on May 5, 2004.

Transmission constraints can impact the simultaneous deliverability of imports and internal generation. As a result, the interaction between the deliverability of imports and the deliverability of generation needs to be examined. The proposed generation deliverability assessment includes, as an input assumption, the amount of imports and existing transmission contract related encumbrances electrically flowing over the ISO Controlled Grid.

One of the observations from the Workshop was that LSEs needed to have results of the deliverability assessments in advance of submitting their resource plans to the CPUC for the year-ahead review. The generation deliverability assessment would provide results in advance. However, the deliverability of imports assessment initially described was an after-the-fact review of all of the LSE resource plans combined.

Because of the need for up-front information the ALJ assigned the ISO to lead a smaller group of Workshop participants to develop a methodology for determining the total amount of import capacity, by import path, which could be available to LSEs. This document describes a proposal for a methodology developed by the subgroup.

Discussion of Proposed Approach

Whatever import capacity is available to LSEs for resource adequacy planning purposes should also be the basis for the import assumptions in the internal generation deliverability analysis. Because of the interaction between the deliverability of imports and the deliverability of internal generation, one should not simply determine the maximum import capability under favorable conditions and make that import capability available to LSEs for developing their resource plans. This approach assumes that all the import capability is needed and will be used for resource adequacy planning purposes, an assumption that could result in impairment of deliverability of internal generation. (This would be inconsistent with the consensus from previous workshops that the deliverability of generation internal to the ISO grid should be preserved.) Furthermore, it is likely that,

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3 Determining a methodology for allocating import capability to LSEs was not an assignment of this working group.
Appendix 1  PRELIMINARY DELIVERABILITY BASELINE ANALYSIS STUDY REPORT

compared to a more reasonable import allocation, more of the allocated import capability
might remain unused by an LSE to meet its resource adequacy requirement at the expense
of more internal generation being available to meet an LSE’s resource adequacy
requirement.

Workshop participants proposed that historical import information should be the basis for
determining the initial amount of import levels to be allocated to LSEs. Following this
suggestion, the ISO reviewed actual import flows and schedules during peak load hours
in 2003. After initial review of the data, it appears that 2003 saw the highest import
levels in the last five years during peak load periods. A subsequent review of 2004
import flows during peak load hours showed similarly high import levels.

In addition to using historical data, existing transmission contract (ETCs) information
should also be utilized. It is assumed that the entities that have contracted for the
transmission capacity are already relying on this import capability in their resource plans,
so this transmission should not be reallocated.

The impact of these total import levels would likely affect the deliverability of some
existing generation, and the interplay between the deliverability of these existing
generators and imports needs to be addressed. One of the key benefits of this proposed
approach is that a clear deliverability benchmark would be established up front, it would
be the starting point for future years, and LSEs would have some flexibility within this
structure to adjust their resource adequacy plans to find an appropriate balance between
imports and existing generation inside California.

Proposed Methodology

Initial Import Level
The proposed approach for combining both historical information and contractual
information is to add final transmission net import schedules (day-ahead, hour ahead, and
real-time) not associated with ETCs, to ETC reservations on a path by path basis. One
could then verify that this sum would not have exceeded the historical Operational
Transfer Capabilities (OTCs) and make the appropriate adjustments. This methodology
could be applied using several historical high load, high import hours and then taking the
average total net import as the initial net import level.

Generation Deliverability Analysis
Using the initial import level as an input assumption, a baseline analysis of the
deliverability of generation to the aggregate of load would be performed as described in
the Generation Deliverability Assessment Attachment. This benchmarking analysis
would establish the deliverability of internal generation.
Make Results of Deliverability Assessment Available for Use

Once the deliverability assessment is completed the results will be provided for use in developing year-ahead LSE resource procurement plans for resource adequacy purposes.\textsuperscript{4} The total import capacity, by path, determined to be deliverable would need to be allocated to LSEs using some allocation methodology that has yet to be defined.

(Optional Step) Modify Results of Deliverability Assessment based on Economic Tradeoff between Import Capacity and Internal Generation Capacity

This step assumes that the deliverability of existing resources may not necessarily be preserved, and could be reduced as needed to increase the deliverability of imports, if it is determined that more economic capacity can be obtained from import levels that exceed the total import capability allocated to LSEs. Some sub-group participants had concerns regarding the logistics of implementing this step, and there is no consensus whether or not this step should be included in this general methodology.

Review of Results of Generation and Import Deliverability Assessment Methodology

As part of the initial implementation of this analysis, the test results for generation and import deliverability should be evaluated to ensure they are reasonable, equitable, and consistent with engineering judgment. Stakeholders would help review the reasonableness of these initial test results, and, if necessary, the deliverability test procedure could be refined.

\textsuperscript{4} Operational requirements of the various local areas (i.e., RMR areas) would need to be addressed so LSEs have the necessary information to develop their resource procurement plans. This includes operational requirements such as the amounts and locations of generation needed to be on line and the potential generation retirements that could increase local area requirements. The deliverability to load methodology should focus on these requirements.