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Escalation Estimation: Working With Economics Consultants

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Escalation can be defined as changes in price levels driven by underlying economic conditions. Escalation reflects changes in price-drivers such as productivity and technology, as well as changes in market conditions such as high demand, labor shortages, profit margins and so on. Escalation also includes the effects of, but differs from, inflation which is a general change in prices caused by debasement of the value of a currency. From an estimator's perspective, escalation it is a unique "risk" cost that must be estimated. Complicating the issue, price escalation varies for different capital project components such as office and field labor, bulk materials, and equipment; it also varies by region and procurement strategy.

Escalation differs from contingency which per AACE International is "an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, and/or effect are uncertain and that experience shows will likely result, in aggregate, in additional costs." By AACE International's definition, contingency specifically excludes escalation although contingency and escalation are both "risk" funds.

Probabilistic approaches are the best estimating practices for both escalation and contingency. However, unlike contingency estimating, cost engineers are poorly equipped to estimate escalation. That is because escalation is driven by macro-economic conditions; the study or which is a "core" skill and knowledge area of economists, not cost engineers.

BACKGROUND—ESCALATION REALITY

In the EPC industry, escalation has been a non-issue since oil prices and associated capital expenditures collapsed in 1986. Most estimators now working have never concerned themselves much with escalation. Estimators could safely assume three percent escalation per year, add it to each budgeted line item, and feel reasonably confident in their estimate. Most projects did not have an "escalation" line item in their budgets. A search of AACE International papers finds very few regarding escalation estimating (A 2006 paper by Peter Morris and William F. Willson is recommended [3]). That being the case, most estimators would never think of bringing in a professional economist to help them estimate escalation.

However, starting late in 2003, commodity prices sky-rocketed as illustrated in table 1.

Commodity Items	Price Increase (9/03 to 9/06)
#2 Diesel Fuel	121%
Iron & Steel	60%
Iron Ore	41%
Non-Ferrous Metals	85%
Industrial Chemicals	55%
Cement	32%

Table 1—Price Increases for Select Commodities
(Sept. 03 to Sept. 06) [4]

Many manufactured items increased in price as well as illustrated in table 2. In general, the more labor and technology content in an items manufacture, the less its price increased.

Manufactured or Fabricated Items	Price Increase (9/03 to 9/06)
Metal Tanks	29%
Heat Exchangers	40%
Pumps and Compressors	15%
Wire and Cable	81%
Motors and Generators	15%
Process Control Instruments	7%

Table 2—Price Increases for Select Commodities
(Sept. 03 to Sept. 06) [4]

Owners reacted to these high prices by quickly pulling every mining, metallurgy, and oil and gas project proposal off their shelves. Despite painful memories of the 1986 oil industry capital spending collapse, engineering of these projects added dramatically to the backlogs of the suddenly short-handed engineering and procurement contractors [1]. Peter J. Robertson, Vice Chairman, Chevron Corporation noted in a keynote address at the Oil and Money Conference in London, England in September 2006, "New investment by the five major international oil companies alone totaled approximately $70 billion in 2005, an increase of nearly 20 percent over the previous year.

Double-digit increases in capital and exploratory spending in 2006 and 2007 seem likely if current trends hold." The thin ranks of owner cost estimators were caught flat-footed and struggled to respond to the estimating needs, and the challenges presented by this workload and the volatile price trends.

In 2004 and 2005, many owner estimators were at a loss as to how to price project cost items. Bid prices from fabricators, suppliers and contractors varied widely (but almost always higher than expected). Suppliers quickly became unwilling to provide fixed price quotations, and those that did included stiff risk premiums in their prices. Escalation clauses became more standard in contracts. Adding to the problem, owner procurement and contracting departments regularly changed their minds about strategies for dealing with the situation.

Given the volatility and uncertainty, many estimators threw up their hands and just prepared their estimates using pre-2003 prices and put all "price risk" costs in an escalation account and few managers could agree on its appropriateness. Other estimators included pricing risk in the contingency account which further muddied this already contentious cost account. Still others tried to include escalation in each control budget line item like they used to, adding uncertainty as to what the control base included.

Aggravating the confusion, the costs of many projects-in-progress (e.g., Sakhalin, etc.) started to rise and news of 50 percent and greater cost increases started hitting the press. By 2006, business managers did not know what to believe about project cost trends, particularly for mega-projects. Fearful of price increases, business management has begun to lean toward excessive escalation funding knowing that project returns (e.g., IRR) would still look reasonable if they could bring the capacity on-line while sales prices were near their peak. This behavior is creating a self-perpetuating situation because, in the industry's weak project control environment, once money is committed, it tends to be spent. Contractors have no incentive to resist this owner generosity, not only because it improves their margins, but because they have their own cost risks in dealing the increased workload.

A RETURN TO RATIONALITY

As a profession, it is time to get our act together and estimate escalation costs rationally. When it comes to escalation estimating, estimators need to start with and understand the following escalation principles.

- it is macro-economics driven and hence affecting everyone's projects,
- it is not contingency, and
- its study is a core skill and knowledge of economists, not cost estimators.

In volatile times, we must work with economists and combine our expertise of project costs with their expertise in macro-economics and price factors.

We also must sort out the jumbled mess that has become of "risk pricing". We need to ensure that everyone agrees as to what is "escalation", what is "contingency", and estimate and manage them distinctly and appropriately. We need to get risk costs back in the right cost account (e.g., not hide escalation in estimate line items) so we can rationally plan execution strategies that effectively mitigate the respective risks, and allow the project team to perform effective cost control.

ESCALATION VERSUS CONTINGENCY

As stated previously, escalation is defined as underlying economics-driven changes in price levels. The important point is that escalation is not driven by the practices used by your company or project management; i.e., it is "macro-economics" and thus largely (though not entirely) out of your control. However, escalation is somewhat predictable. This is important to keep in mind, because the news of massive project costs increases is often the result of poor project practices; escalation is just an aggravating factor. Escalation itself is not doubling or tripling

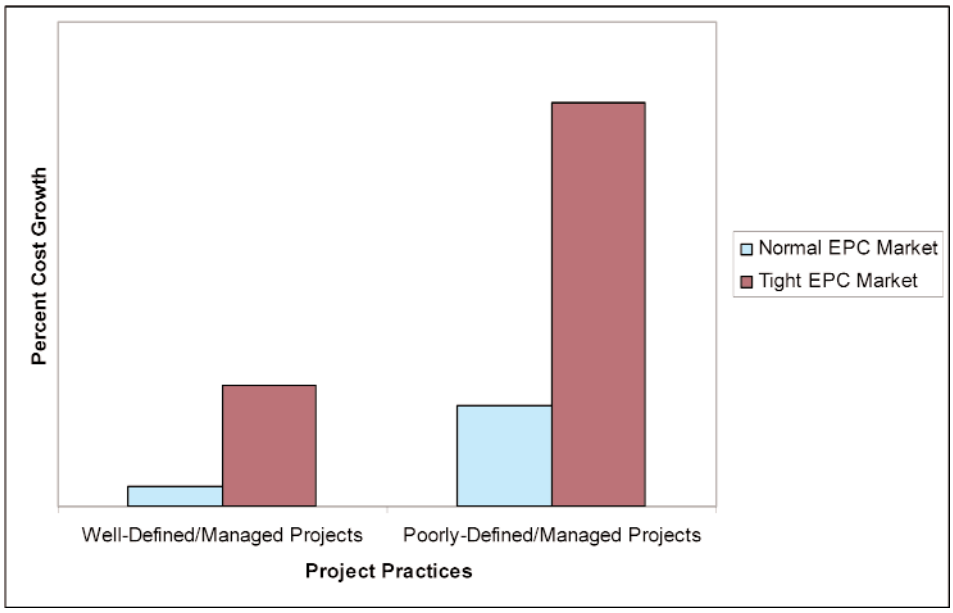

Figure 1—Cost Growth Due to Poor Practices is Not Escalation

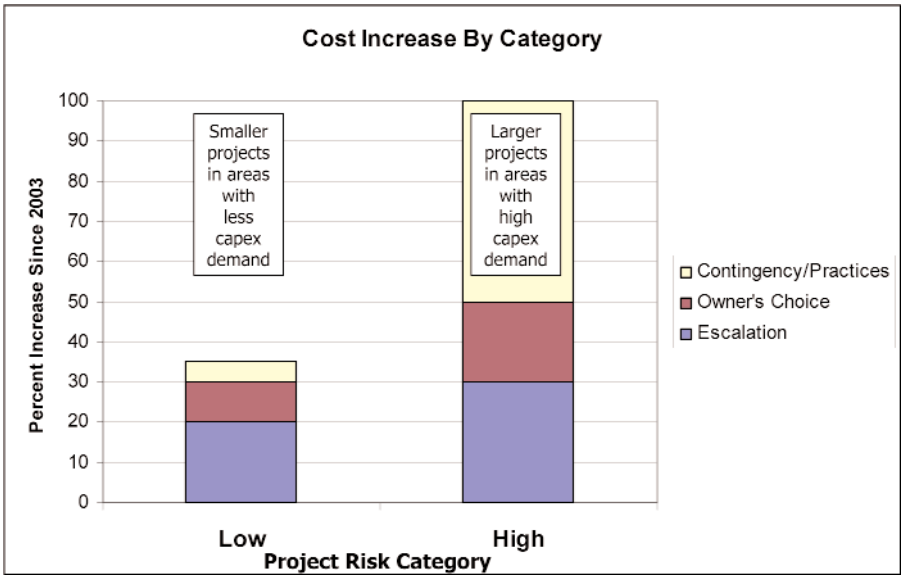

Figure 2—Cost Growth May Result From Escalation, Choices, or Poor Practices

project costs. Poor project practices are a well known cost risk-driver that should be addressed by contingency, not escalation.

Figure 1 conceptually illustrates what happens to project costs in times of tight capital markets, high prices, low construction unemployment, and poor productivity. Even the best defined and managed projects will face price increases driven by underlying economic conditions. However, poorly-defined and/or poorly managed projects become much more likely to become disasters characterized by doubling or tripling labor costs. In other words, poorly defined or managed projects are penalized exponentially in tight markets. This penalty is not escalation; it is contingency risk. Escalation is just a straw that broke the camel's back.

Unfortunately, treating the large poor definition/management cost penalty as contingency works against cost engineers. That is because business management has an ingrained dislike of "contingency" (i.e., they see it as "fat") and managers are unlikely to be receptive to the idea that their own poor practices are what is causing much of the cost growth. So, escalation has become a politically correct hiding place for this contingency.

Another principle to understand is that escalation is not costs that result from management project scope and execution strategy choices. For example, given the recent backlogs and delays in fabrication yards, some owner's are selecting the high-price bidder (if they can find multiple bidders) to increase the odds that their equipment will be shipped first. The higher price they are paying is not escalation; it is a choice to include in the base cost estimate. Similarly, choosing to offer extensive incentives to contractors (overtime, labor rate premiums, etc.) is an owner management choice. A more cost effective choice may be to slow down project schedules, but few business managers will accept that course of action because they are desperate to start-up their plant when prices are at their peak.

One cost that may or may not be considered escalation is the premium prices being charged by suppliers and contractors. At some level, this is a "macro" trend that all companies face; owners have very limited means to affect that portion of the premium price that is because of higher industry profit margins. There are few suppliers and contractors that can handle mega-projects, particularly in remote locations, so they have more pricing-power (they are also less concerned with relationship building). However, the portion of the price that is contractor "risk premium" is affected by owner choices. Specifically, if the owner chooses to push all risks to the contractor by using fixed price contracting, then the higher contractor prices are the result of the owner's choice, not escalation.

To summarize, figure 2 conceptually parses the general trends in capital project price increases into escalation (including contractor's higher margins), owner's choice, and contingency risk (because of poor practices). As prudent stewards of a company's capital funds, it is recommended that estimators similarly analyze and breakdown the "risk costs" on their projects and make sure management understands what is going on and can manage the costs better.

ECONOMISTS, MACROECONOMIC FORECASTING

The next principle to understand is that price escalation is tied to macro-economic trends; the study of which is a core skill and knowledge of economists. The primary econometric measures of price change over time (i.e., escalation) used by economists are price indices. There are three basic types of indices available; commodity indices (e.g., steel price), labor price indices (e.g., compensation), and economic indices (e.g., capital spending trends).

The index is usually expressed as a percent change in price over a given time period, or an index representative of the price level at a given time. For example if the price index for a product is given as 1.00 for 2007, and prices increase 5.0 percent to 2008, the index for 2008 will be 1.05.

The primary sources of historical price indices are government agencies such as the US Bureau of Labor Statistics (BLS), Eurostat, or Statistics Canada to name a few. Most of the indices published in magazines (e.g., **Chemical Engineering Plant Cost Indices**) are derived from the government sources. The BLS data is searchable and available online free of charge. Other agencies may charge low nominal fees for their data.).

Economists study these historical trends and build econometric models that forecast future price index values, generally at a disaggregate level. The models of price change for specific commodities are usually tied to macro-economic models that define the underlying economic conditions that drive all prices to some extent. These index forecasts are a for-fee service available through subscription or on a consulting basis with the economists. The authors have found very little useful forecast data that is available for free.

In working with economics consultants, estimators must recognize that economists are generally not experts in capital project costs and the EPC market. Also, they do not have tailor-made indices for your project costs. Many companies are frustrated because the economists do not have canned solutions for them. Estimators and economists must work together to find a set of price indices that can serve as proxies for elements of your project costs. It is then the estimator's responsibility to apply the indices.

APPLYING PRICE INDICES TO PROJECT COSTS

At an elementary level, using forecast indices to estimate escalation is easy. If your estimate for an item is $A in 2007 (i.e., the "base" year is the time that the estimate is prepared), then the cost in 2010 is: $A x (2010 index/2007 index). Escalation is then the escalated cost minus the "base" cost.

It is a challenge to determine the best way to apply disaggregated indices to the overall plant costs (for which no one reliable aggregated forecast index is available). The historical and forecast indices available are usually in a disaggregated format. In other words, there are separate indices for each of the major resources that go into or make up a project's cost structure. For example, the BLS provides indices for wages of various classes of workers, and product prices for steel, pipe, electrical motors and so on.

The estimator must then break down the project cost estimate into categories of costs for which applicable price indices are available (e.g., engineering labor, steel, etc.). This is not always a straight-forward task. For example, a typical process plant has significant pipe material costs. Most of the piping material cost is for pipe spools from a fabricator. The spool price includes the cost for pipe, fittings, and shop labor costs. The available disaggregated indices do not cover spool prices; therefore, the estimator must create an aggregate or "proxy" index for shop fabricated pipe that includes a weighted mix of pipe costs, fitting costs, and shop labor.

The economists can provide forecasts for hundreds of wage, price and other indices. As the estimator builds up weighted indices or otherwise lines up cost categories with indices, there is a risk of going overboard with detail that can greatly complicate the effort without adding much accuracy. For example, there may be wage indices available for many different crafts, but in general, they follow the same trend. Using one of these indices as a proxy measure for all crafts may be appropriate. For weighted indices (e.g., fabricated pipe) some costs can be ignored in the weighting if they are less than about five or 10 percent of the total (e.g., primer paint on pipe spools).

It is the authors' experience that typically no more than about 15 to 20 price indices (used in different combination of weighted indices) are necessary to effectively estimate process plant cost escalation (depending on plant scope and regions covered).

The following criteria are used by the authors in selecting and developing price indices for use in escalation estimating:

- Use or are based on industry or government sources that are generally recognized as reliable and are readily available.
- Be generally applicable to the subject industry in the primary regions where a company performs or will perform capital projects.
- Be specific to the major cost types found on all the company's projects. And,
- Be easy to update, modify and maintain as an ongoing reference source.

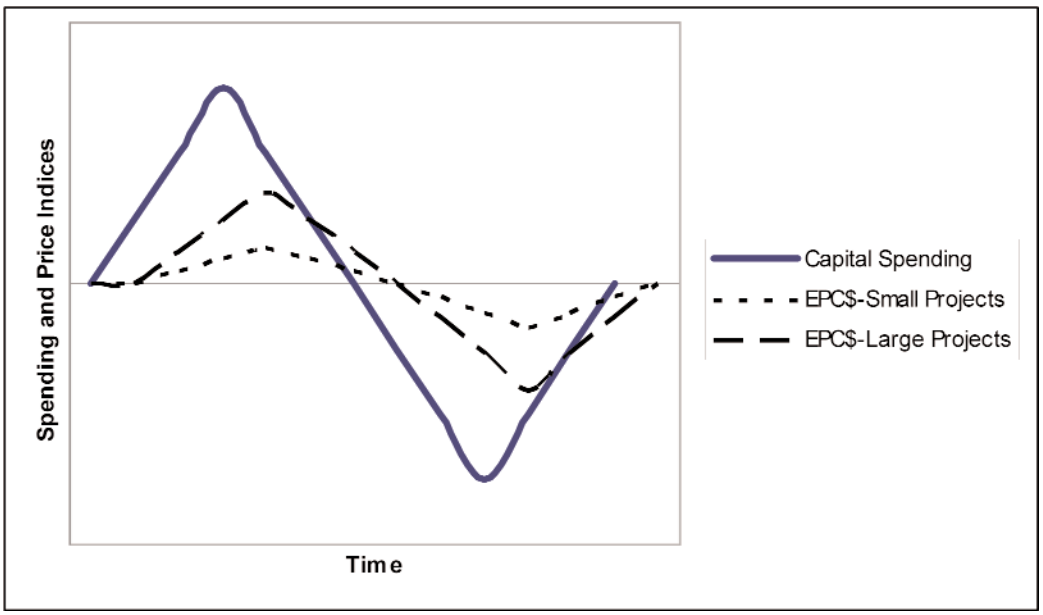

Figure 3—EPC Labor Prices Vary With Trends in Capital Expenditures

FACTORING IN THE EFFECTS OF EPC CAPITAL MARKETS

Another challenge to using indices is how to deal with the fact that they do not track "micro-economic" trends. For example, the process plant engineering, procurement and construction (EPC) industry is a micro-economy where labor prices have increased much more than the engineering and construction wages that the government agencies and economists track. This is because contractor's prices include markups such as risk premiums, productivity factors, and markups. No one tracks EPC bid prices per se. While in the long run, underlying costs such as wages drive trends, market strength can be the dominate driver in the short run (e.g., since 2003).

In this situation, estimators must add their knowledge of the EPC industry to the economist's knowledge of macro-economic trends. The authors' approach to the market challenge is to adjust the available labor pricing indices with additional factors that reflect the relative level of capital expenditure in the EPC market. For example, if EPC investment increases substantially in a year, EPC contractors will be able to exert their market strength and raise bid prices in some proportion to the rate of capital spending increase. Figure 3 below conceptually illustrates how EPC engineering and construction prices for small and large projects tend to vary with the level of capital spending for process plants (which is a micro-economy).

Note that small project price trends vary less and EPC pricing level changes tend to lag changes in the economy a bit. There is no doubt that labor pricing is linked to the relative level of capex in the process industries (and construction employment). The experience of the oil spikes in the 1970s and 80's demonstrated that [5]. The only uncertainty is the extent that capex affects labor price on a given project in a given region. Also, the capex effect is least on small projects using local contractors with long standing relationships. The effect is greatest on large projects; particularly those in more isolated regions with smaller labor pools such as Alberta Canada or Western Australia (i.e., places where most of the oil and metals tend to be found and processed).

Factoring market demand affects into labor price indices has not a common practice. However, it is necessary that this be done because published indices only cover compensation which tends to be fairly stable. They do not track the prices that owners pay. For example, the BLS-based **Chemical Engineering** magazine **Plant Cost Indices** for engineering and construction labor costs have been more or less constant since 2000. However, there is no doubt that global engineering and construction firms have commanded increasing prices since 2003, particularly for large projects. For example, Ed Merrow, owner of the benchmarking firm Independent Project Analysis, has estimated that engineering and construction margins have increased from two to five percent in the 1990-2002 period to 10-12 percent in recent years on a risk-free basis [2].

USING PRICE INDICES TO NORMALIZE HISTORICAL PROJECT COSTS

Just as forecast price indices can be used to estimate future escalation, historical price indices can be used to normalize past project estimated or actual cost to a current year basis. For example, if the cost for an item is $A in 1995 (i.e., the estimate "base" year or the time of commitment), then the cost in 2007 is: $A x (2007 index/1995 index). As with escalation estimating, normalization has become a critical task because most owners base their feasibility and conceptual estimates to some extent on past project estimates or the costs of completed projects. Without normalization, the value of historical cost databases is greatly diminished.

ESCALATION ON CONTINGENCY (AND ESCALATION RISKS)

Contingency, by definition, is a cost expected to be spent. Therefore, it is logical to apply escalation to contingency like any other estimated cost account. The weighted index for contingency will typically reflect the weighting of cost accounts for the project as a whole. A forecast of contingency drawdown will be needed to estimate escalation on it.

Estimators must also keep in mind that there is escalation risk. Price index forecasts from economists can be considered their most likely, or 50 percent probability estimates. If your company funds projects at a different level of probability of underrun, you will need to consider how to adjust the escalation estimate. One risk is that the project schedule will slip which can greatly increase base cost as well as escalation cost; estimators will need to be clear on whether the cost risk of slip is included in contingency or escalation.

CUSTOMERS, BUSINESS AND POLITICS

Another challenge that many cost estimators will face in escalation estimating is that the customer of the estimate will have their own economics and/or escalation forecasts. Often these forecasts are little more than old rules of thumb (e.g., three percent cost increases per year). In other cases, the business is basing its revenue projections on certain economic assumptions (e.g., oil will be >$45 per barrel through 2010); the estimator will need to communicate this scenario to the economists and request special index forecasts based on this economic assumption so that the capital cost estimate basis is consistent with the business' rate of return analysis. Differences in assumptions between the business and the economists need to be rationalized.

PUTTING ESCALATION ESTIMATING/ECONOMICS KNOWLEDGE AND TOOLS INTO ACTION

The principles of escalation estimating outlined above are fairly straight-forward. However, putting them into practice can be a significant effort for owner cost estimators that have very little time on their hands. Certainly, no one wants to or has the time to build unique indices for each estimate; the only efficient estimating method is to build a tool to automate the process.

The steps for developing an escalation estimating tool include the following:

- Get buy-in on the approach from the engineering and business communities.
- Decide on the cost account breakout to use for escalation estimates (preferably based on your standard cost code of accounts—keep it simple).
- Select and contract with an economics firm that can provide the historical and forecast indices you need.
- Obtain the up-to-date indices from the economist and develop weighted indices for each of your project estimate cost accounts.
- Make adjustments to the weighted indices as needed, particularly for capital demand trends.
- Determine the estimated project cash flow by cost account.
- Apply the indices appropriately to the cash flow for each cost account. And,
- Decide how to handle escalation on contingency and escalation risk.

The authors' firms, Conquest Consulting Group and Validation Estimating LLC, working under an alliance called the Center for Cost Engineering (C4CE), have been through this process for a variety of companies. C4CE has an Excel-based escalation estimating and normalization tool that can be tailored for a given company's project types and locations. C4CE is also familiar with the products and services of agencies (e.g., BLS, StatCan, etc.) and economic consultants (e.g., Global Insight, Oxford Economics, etc.) and has expedited making arrangements to obtain the necessary forecasts and historical data.

ACCURACY

Estimators are cautioned not to expect too much accuracy from cost indexes. The indices are approximations intended to represent the average trends for a large group of projects in a broad region. The indices are generic and conceptual in nature and judgment must be applied in using them in any given situation. In and of themselves, escalation estimates should be considered Class 5 estimates per AACE International's classifications regardless of the Class of the base estimate.

Estimating cash flow is another source of escalation estimating inaccuracy. If you are using the indices to normalize project costs, you also need to determine the year that most of the costs for a given account were either committed or expended as appropriate.

Another index accuracy issue is pricing time lag. When prices change rapidly at some point in the supply chain (e.g., 2003 steel prices), the cost of some items or services may or may not be affected immediately. The prices paid will eventually catch up with the index trends, but prices may lag by a few months or even a year.

Finally, caution must be used in applying the indices to any single item. For example, in the 1990's the price and delivery times of large combustion gas turbines (manufactured by just a few companies) increased dramatically when scores of independent power projects hit the drawing boards, yet the BLS index for pumps and compressors barely budged.

This paper has presented some basic escalation estimating principles and methods that will allow estimators to estimate escalation costs rationally. A key learning from the authors' experience has been that in times for price volatility, estimators cannot go it alone in developing escalation estimates; they need to work with economics consultants. Also, demand-adjusted indices and standardized tools for their application will greatly expedite the estimating process and increase confidence in the results.

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