Kuparuk River Unit Capacity Details

KRU Process Capacity Details

Figures 1 through 3 show CPF historical production for the major fluid components along with an approximate 'capacity bar'. These figures all show similar information that can be described as follows:

- Oil production is the amount of oil, which enters the separators. The capacity bar represents the oil train capacity limit that is dictated by separator, pump, and other miscellaneous components.

- Water production is the amount of water (both produced water and jet lift water), which enters the separators. The capacity bar represents the water train capacity limit that is dictated by separators, pumps and other miscellaneous components.

- Total liquid production is the amount of oil and water that enters the separators. The capacity bar primarily represents the separator limit to handle liquids.

- Front End Gas is gas which enters the first stage of gas compression. The capacity bar represents the gas train limits for processing gas into the tie-line. These limits are due to separation, compression, dehydration and other miscellaneous components. Weather is also a critical factor (warm weather lowers capacity) and that is the reason for the regular oscillations in the history and capacity bar.

- Water injection is water (produced, seawater and recycled jet lift), which enters the water injection pumps. The capacity bar primarily represents water pump capacity.

The capacity bar represents our estimate of current capacity. There is a degree of uncertainty concerning the capacity bar. Multiple system constraints and variables (including weather) come in to play to define the capacity. System reliability or 'on time' is also a critical variable impacting effective capacity. In most cases, recent history is probably a fairly good capacity indicator; we know that capacity is at least at that level. Distant history is probably not a good capacity indicator because systems degrade, equipment is changed and modified, and other factors act to alter effective capacity. The only accurate way to get a good or 'hard' number for capacity is to test it directly. In a few cases, such as gas and water trains at particular locations, hard capacity limits have been reached and are known. For most cases, the capacity limits are 'soft' and not well defined. The bottom line is that no guarantee can be placed on the overall system capacity or even at any particular point in the system without being excessively conservative

Before looking into detail concerning individual CPF history and capacity, it is important to look at total KRU history because that provides a basic understanding of the overall situation. Figure 6 shows total KRU production history. As can be seen from the plots on this figure, although KRU oil production has declined.

Water, total liquid and gas production have increased and are at or near historic levels. Improvements have been made over the years to increase capacity and keep pace with the escalating 'secondary' production streams of water and gas. Excess capacity has not generally been installed so many of the facilities are operating near peak utilization in many systems.

Figure 1 shows CPF1 history and capacity. Currently, there is very little shut-in or limited production of CPF1 wells due to facility limits. The important points concerning CPF1 production are as follows:

- Oil – The oil production shown here includes the oil that flows from CPF3 into the CPF1 secondary separator. There is currently capacity for additional oil production at CPF1 subject to potential KPL capacity limitations. In the future, West Sak developments will close this capacity gap.

- Produced Water – There is currently some additional water production capacity at CPF1. In the future, West Sak developments may produce a significant amount of water. Generally, total liquid limit (see next bullet) is more restrictive than either the oil or produced water limit.

- Total Liquid – Total liquid is near separator capacity. Increasing amounts of heavy oil production associated with the development of West Sak may reduce this future limit to below historical performance.

- Front-End Gas – Gas production is near capacity. Upgrades are pending for the gas compressors at CPF1 which will minimally improve capacity.

- Water Injection - Water injection is near capacity.

Figure 2 shows CPF2 history and capacity. Currently, there is very little shut-in or limited production of CPF2 wells due to facility limits. CPF2 has a significant amount of satellite production. The important points concerning CPF2 production and capacity are as follows:

- Oil – The oil production shown here includes the oil that flows from CPF3 into the CPF2 primary separator. There is currently capacity for additional oil production at CPF2 subject to potential KPL limits.

- Produced Water – There is currently some capacity for additional water production at CPF2. As at CPF-1, total liquid capacity is generally more limiting than either oil or water handling.

- Total Liquid – Total liquid production is near separator capacity.

- Front-End Gas – There is a slight amount of capacity for additional gas. In 2002, one new electric driven gas compressor was installed at CPF2, which increased capacity.

- Water Injection – Under current operating conditions, there is a shortage of water pump capacity at CPF2. The pump capacity is sufficient to inject all of the produced water and some seawater. However, additional seawater injection is needed for the combined demands of jet pump lift and voidage replacement water. A study is ongoing to determine if a pump capacity upgrade is warranted.

Figure 3 shows CPF3 history and capacity. Currently, there is very little shut-in or limited production of CPF3 wells due to facility limits. The KPA field extension DS-3S (Palm) has recently increased production into CPF3. The important points concerning CPF3 production and capacity are as follows:

- Oil –There is capacity for additional oil production at CPF3. It is important to account for the fact that CPF-3 oil and water capacity will also be limited by CPF-1, CPF-2, and KPL capacity limits.

- Produced Water – There is some capacity for additional water production.

- Total Liquid – There is some capacity for additional total liquid production.

- Front-End Gas – There is very little capacity for additional gas.

- Water Injection – There is capacity for additional water injection.

Figure 4 shows field gas injection or 'back-end' history and capacity. This essentially represents the compression required to inject either lean gas or MI gas into the reservoir for enhanced oil recovery and gas management purposes. Recent upgrades to this system have provided for some very slight additional capacity over current requirements.

Figure 5 shows the Kuparuk Seawater Treatment Plant historical water delivery. Operational conditions have lowered output capacity from historical peaks.

Electrical power is a key requirement to run the facilities. Right now, there is some spare capacity. With the recent CPF2 gas capacity expansion (electric powered) and future requirements for West Sak and potentially Ultra Low Sulfur Diesel, electrical capacity may be at a premium in the near future. Expansion of electrical generation capacity is under ongoing consideration as new projects are proposed.

KRU Process Capacity Summary

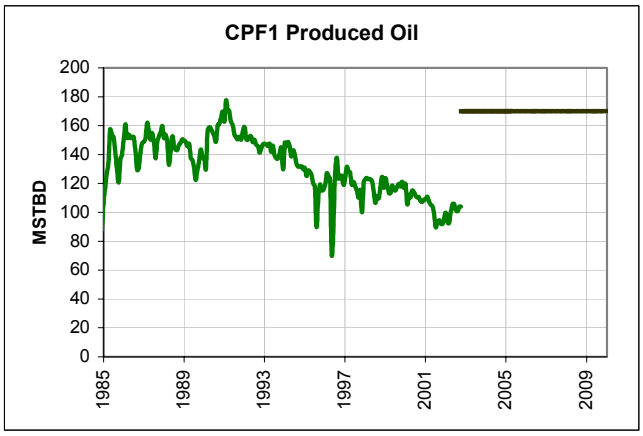
Figure 6 summarizes the overall capacity situation. Overall, the current KRU capacity situation is very good. In general, few wells are shut-in or curtailed due to capacity constraints. Well production capacity and process capacity are near balance. There is spare oil train capacity but water, total liquid and gas production are near capacity limits. Capacity upgrades have been made as necessary. Currently, CPF2 water injection pump capacity and electric power issues are being addressed.

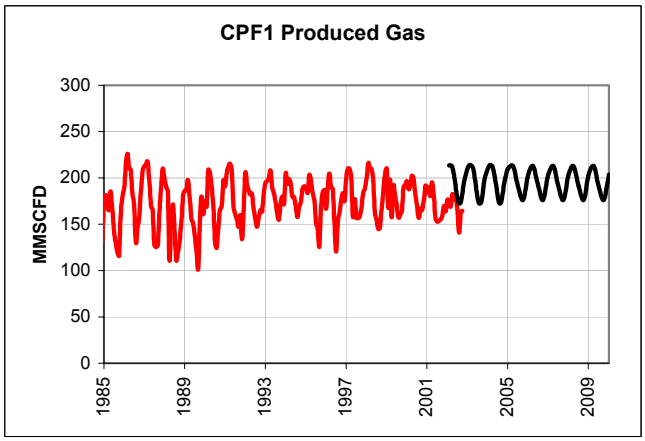
At this time, production and process capacity are in balance but there is no pure spare capacity for new production. New production brought on line will likely cause some backout. Depending on the quantity, if the new production is nearly 'pure oil' then the backout impact will be relatively small. If the new production contains large amounts of water or gas along with the oil, the backout impact could be relatively large.

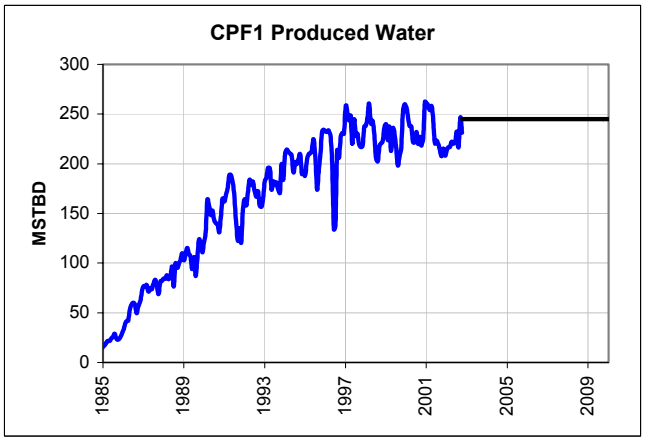
There is no guarantee that this balance between existing production and process capacity will exist in the future. Various factors (such as significant gas breakthrough from the enhanced oil recovery program) could alter the balance and put the system in a more constrained or unconstrained situation.

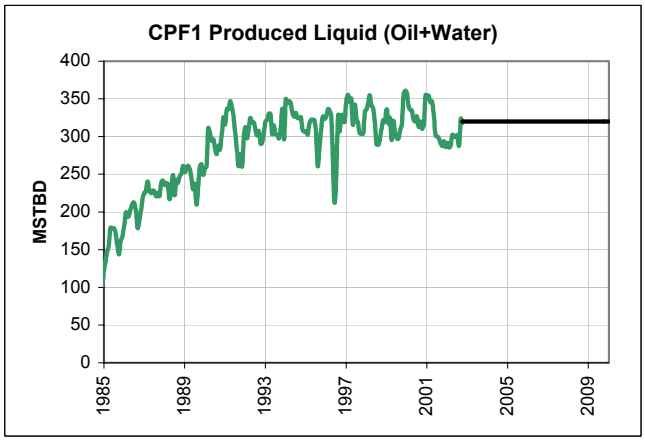
If additional production is brought on line such that process capacity is exceeded or if there is a disruption in process capacity, then a thorough analysis is performed to maximize oil production through the facilities. In essence, 'best well produces' regardless of ownership. For example, if there is a shortage of produced water capacity, then wells with the highest water to oil ratio would be shut-in or curtailed. Quite often, especially in the case of front-end capacity shortages where gas lift supplied to wells is a critical issue, wells are curtailed by decreasing gas lift to the wells rather than shutting-in the wells completely.

Figure 1. CPF1 Production History









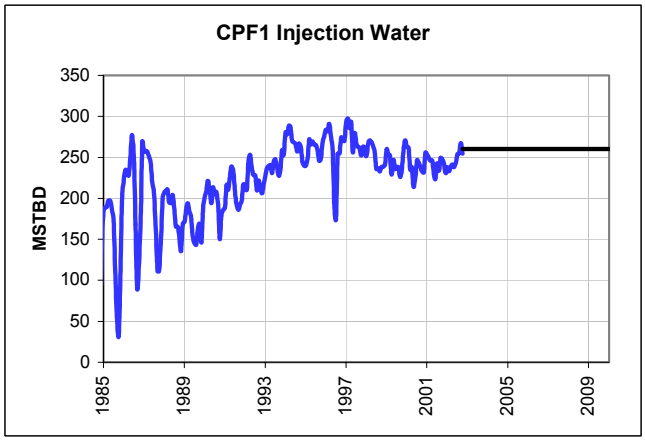
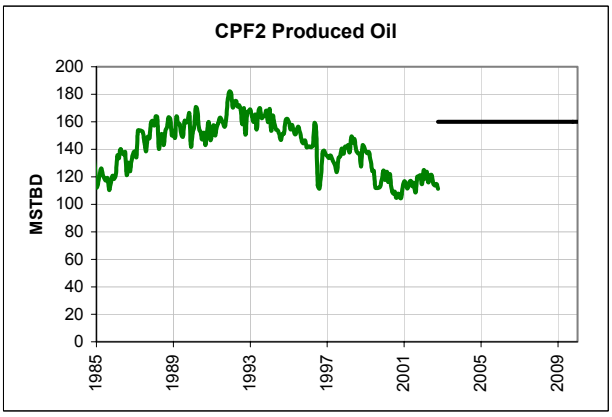
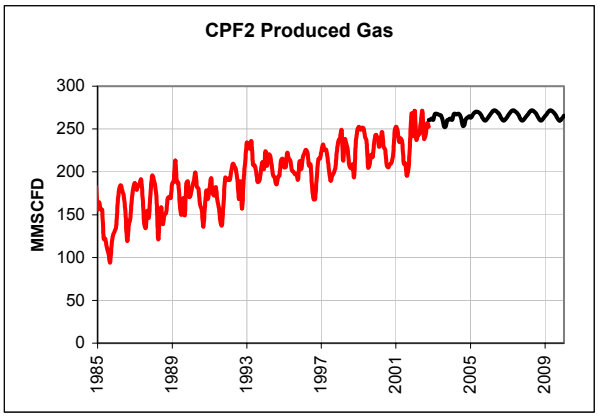
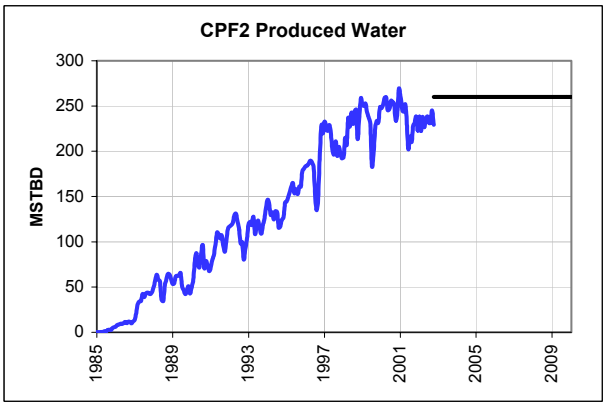
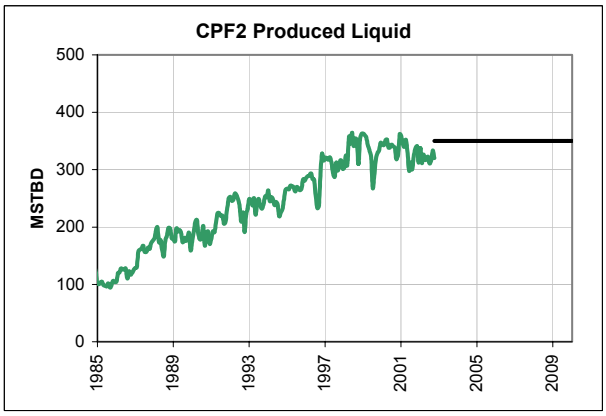


Figure 2. CPF2 Production History









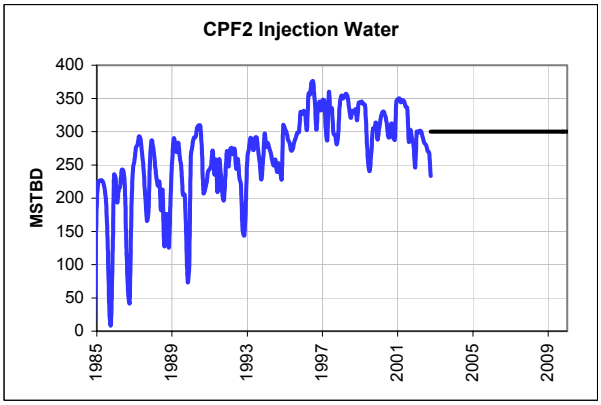
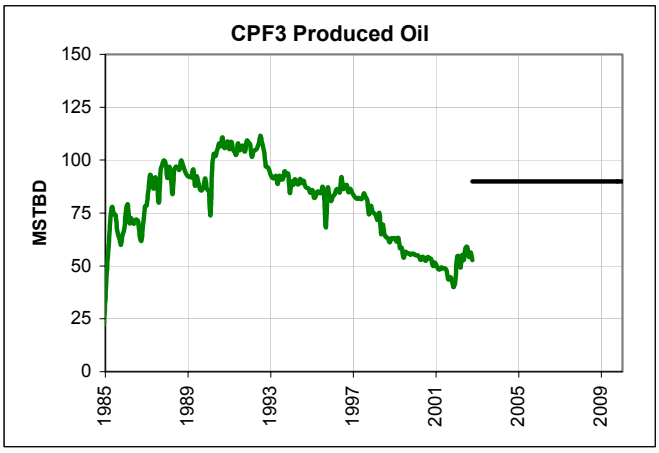
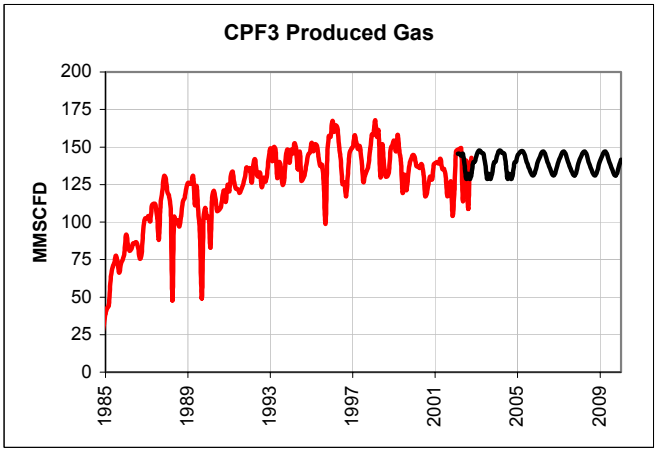
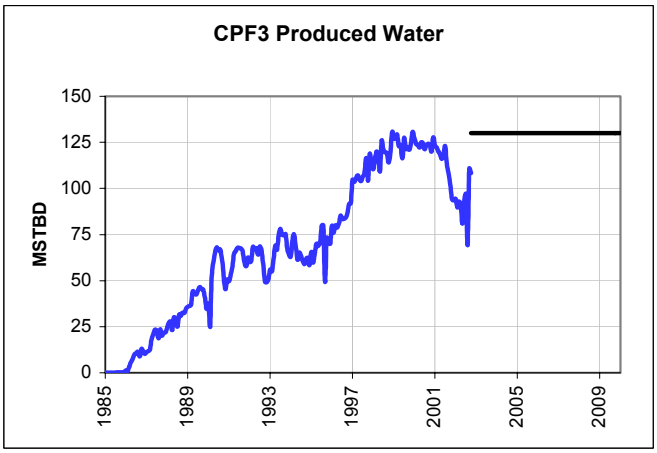
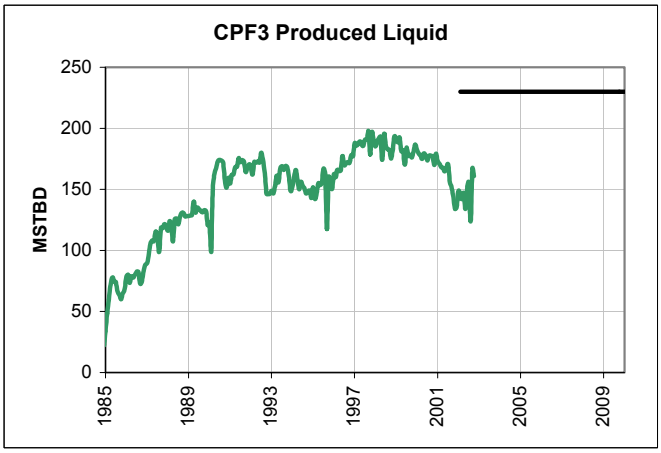


Figure 3. CPF3 Production History









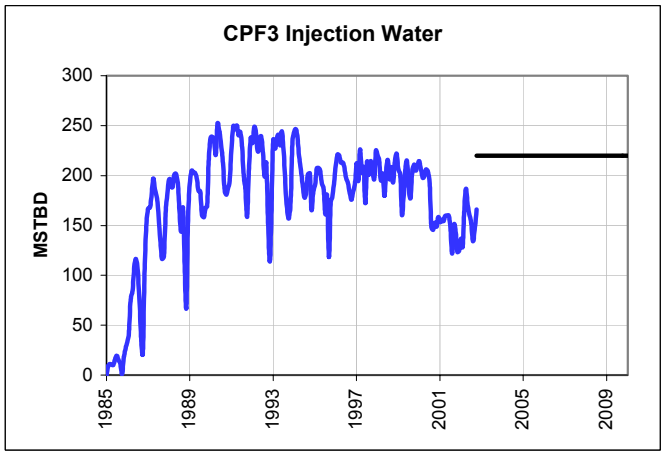


Figure 4. Gas Injection (Back-End) History

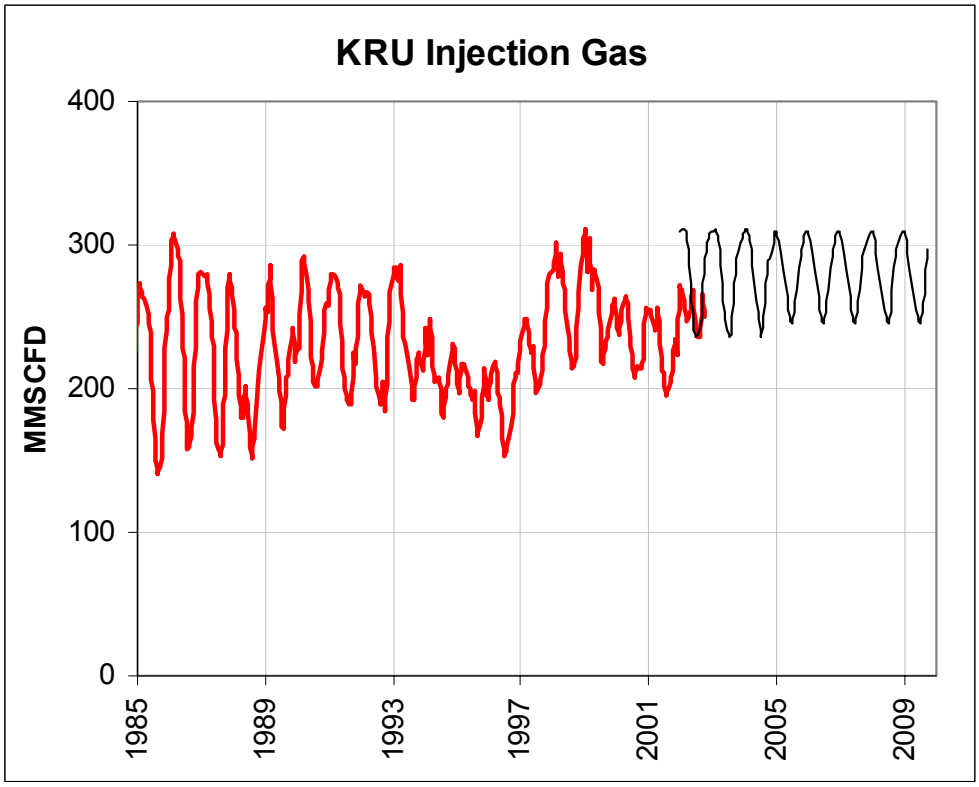


Figure 5. Seawater Treatment Plant History

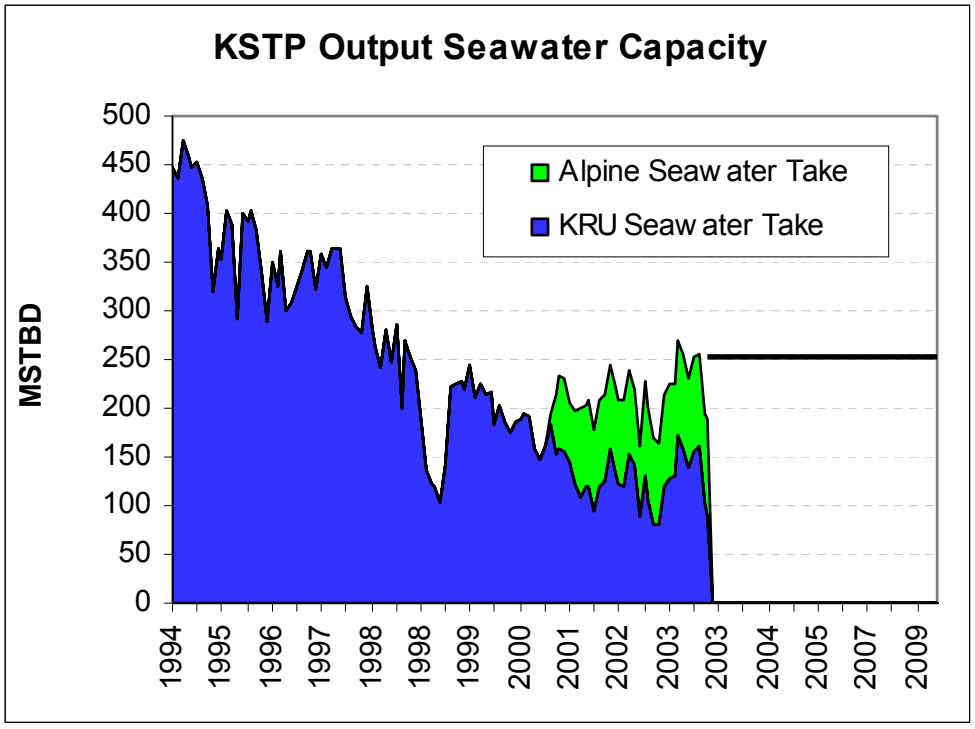


Figure 6. KRU Capacity Summary