SSG-WI 2015 IRP - RPS Reference Case

Production Cost Modeling Results

- Changes Applied since 12-22-05 meeting
- Production Cost Results
- Congestion Costs
- Path Flows
- Post-SSG-Wi: Refinements to Database

January 30, 2006

SSGwi

Seams Steering Group of the Western Interconnection

Path Changes since the 12/22/05 Presentation

Confirmed by the Transmission Sub-Group

Interface	Changes applied
Coronado to Silver King	▪ Reinstated Coronado to Silver King line and added series comp
Bridger West	▪ Adjusted back to today's 2200 MW ▪ Added New WYO - UT = 1700 MW ▪ Path C – adjusted back to today's 775 MW
EOR	▪ Changed path monitoring to capture PV to Devers #2 line flows
Fourcorn to Pnpkaps 500 KV	▪ Corrected R & X values
Marketplace to Adelanto	▪ Deleted a duplicate entry that was limiting it to 1200 MW
Montana to Northwest	▪ Added series comp on line 2 ▪ Changed flow direction on two Anaconda to Garrison branches ▪ Increased capacity from 2200 to 2950 MW
Montana to Southeast	▪ Changed line orientation on the 2 –HARDING-CROSOVRUM
Moenkopi to El Dorado	▪ Increased rating on Moenkopi to El Dorado from 1645 to 1900 MW; rating now ▪ Added Moenkopi to Market Place line (Increased EOR path capacity by 1000)
Northwest to Canada	▪ Added the Western lines as a separate path
San Diego import limit	▪ Reversed direction of branch at San Onofre
Sylmar to SCE	▪ Increase rating from 1200 to 1600 (new Xfmr at Sylmar) ▪ Reconnected lines at both terminus to eliminate circulating flows
Southern New Mexico (NM1)	▪ Reversed direction of Belen to Bernardo
West of Hatwai	▪ Reconfigured monitored lines
WOR	▪ Changed path monitoring to capture PV to Devers #2 line

Branch Changes since the 12/22/05 Presentation

Confirmed by the Transmission Sub-Group

Interface	Changes applied
Gregg to Hentap1	▪ Doubled line capacity by changing the impedance (previously, new generation had been adde without transmission)
Hassayampa to North Gila	▪ Changed line ratings to reflect capacitor upgrade
Imperial Valley to San Diego	▪ Removed one of the two IV San Diego 500kV lines
North Gila to Imperial Valley	▪ Changed line ratings to reflect capacitor upgrade
Miguel Bank Monitoring	▪ Now monitoring the 500/300 kV banks
PV to Devers	▪ Both CAISO and Imperial submitted data in their respective change files to add PV to Devers #2. Correction was made to eliminate duplication ▪ Changed line ratings to reflect capacitor upgrade
Panoche to Helm	▪ Removed line monitoring (previously, generic generation had been added without transmission)
Poe to Rio Oso	▪ Removed line monitoring (previously, hydro had been added and artificially aggregated at POE)
Rosefill to Folsom	▪ Removed line monitoring (previously, generic generation had been added without transmission)
Warner to Wilson	▪ Removed line monitoring (previously, generic generation had been added without transmission)
West of Devers Upgrade	▪ Upgrade single circuit to double circuit: 1) Devers to San Bernardino and 2) Devers to Vista

Generation Changes since the 12/22/05 Presentation

Issue	Changes applied
Alberta resource mix	▪ Reduced incremental additions by a net 2,800 MW to reflect upgrades to old units and subtraction of auxiliary load on co-generation units. ▪ Reduction entailed edits to 50+ separate thermal generation units, both coal and gas.
Overloaded busses	▪ Changed bus assignment of 17 incremental units (6,500 MW). Their initial bus assignments had caused the assigned buses to be overloaded, as they already had significant generation attached
PAC IRP wind resources	▪ Added 700 MW (nameplate) of new wind in the SW-WYO bubble to reflect 2004 PAC IRP

SSG-WI Path Limits

WECC Catalogue Operating Limits & Adjustments Made by SSG-WI

Confirmed by the Transmission Sub-Group

Interface Name	Forward Limit (MW)	Reverse Limit (MW)	Interface Name	Forward Limit (MW)	Reverse Limit (MW)	Interface Name	Forward Limit (MW)	Reverse Limit (MW)
ALBERTA - BRITISH COLUMBIA	700	-720	Jojoba - Kyrene	1732	-1732	PV West	3600	
ALBERTA - SASKATCHEWAN	150	-150	LUGO - VICTORVILLE 500 KV LINE	2400	-900	SCIT	17700	-17700
ALTURAS PROJECT	300	-300	Market Place - Adelanto	1636	-1636	SDGE Import Limit	4000	
BONANZA WEST	785		Mccullgh - Victorville	1385	-1385	SILVER PEAK - CONTROL 55 KV	17	-17
BORAH WEST	2557		MIDPOINT - SUMMER LAKE	1500	-600	South of Alston	3050	
BRIDGER WEST	2200		MIDWAY - LOS BANOS	5400		South of Lugo	6100	-6100
BROWNLEE EAST	1850		Miguel - Tijuana	912	-912	South of Navajo	2264	
CHOLLA - PINNACLE PEAK	2700		Miguel Bank No. 1	1120	-1120	SOUTH OF SAN ONOFRE	2500	
COI	4700	-3675	Miguel Bank No. 2	1120	-1120	SOUTHERN NEW MEXICO (NM1)	1048	-1048
Combined 4a 4b	1096		Moenkopi - El Dorado	1900	-1645	SOUTHWEST OF FOUR CORNERS	5325	
CORONADO - SILVER KING - KYRENE	1600		Mohave - Lugo	1386	-1386	SYLMAR - SCE	1600	-1600
Crystal - H Allen 500 kV PS	1300		MONTANA - NORTHWEST	2950	-1350	TOT 1A	800	-800
Crystal - H Allen230 kV PS	950		MONTANA SOUTHEAST	600	-600	TOT 2A	690	-690
Devers - San Bernardino 1(Post Outage)	317		N. Gila - Imperial Valley	1905		Tot 2a 2b 2c Nomogram	1570	-1600
Devers - San Bernardino 2 (Post Outage)	458		Navajo - Crystal	1900	-1900	TOT 2B	780	-850
Devers - Vista 1 (Post Outage)	458		Navajo - Moenkopi	1411		TOT 2B1	560	-600
Devers - Vista 2 (Post Outage)	494		NORTH OF JOHN DAY	8600	-8600	TOT 2B2	265	-300
Devers Bank No. 1	1120	-1120	North of Miguel	2000		TOT 2C	300	-300
Devers Bank No. 1 (Post Outage)	1230		NORTH OF SAN ONOFRE	2440		TOT 3	1800	-1800
EAGLE MTN 230_161 KV - BLYTHE 16	72	-218	NORTHERN NEW MEXICO (NM2)	1800		TOT 4A	810	-810
East of PV	6970		NORTHWEST - CANADA	2000	-3150	TOT 4B	680	-680
Eldorado - Lugo	1386	-1386	NW to Canada East BC	400	-400	TOT 5	1675	-1675
ELDORADO - MCCULLOUGH 500 KV	2598	-2598	NW to Canada West BC	2000	-2850	TOT 7	890	
ELDORADO - MEAD 230 KV LINES	1140	-1140	PACIFIC DC INTERTIE (PDCI)	2800	-2100	WEST OF BROADVIEW	3323	
EOR	10255		PACIFICORP_PG&E 115 KV INTERCON.	100	-45	WEST OF CASCADES - NORTH	10500	-10500
Hassayampa - N. Gila	1905		Path 26	4000	-3000	WEST OF CASCADES - SOUTH	7000	-7000
IDAHO - MONTANA	337	-337	Path 45	408	-800	WEST OF COLSTRIP	3348	
IDAHO - NORTHWEST	2400	-1200	PATH C	775	-850	WEST OF CROSSOVER	3348	
IDAHO - SIERRA	500	-360	PAVANT INTRMTN - GONDER 230 KV	440	-235	WEST OF HATWAI	4277	
IID - SCE	1500		Peacock - Mead	508	-508	WOR	11823	
Imperial Valley - La Rosita	797	-797	Perkins - Big Sandy	1238	-1238	WOR - IID230	600	-600
Imperial Valley to Miguel	2200		PERKINS - MEAD - MARKETPLACE 500	1400		WOR - N.Gila	1861	
INTERMOUNTAIN - GONDER 230 KV	200		PG&E - SPP	160	-150	WOR -n- El Dor to Lugo	2754	
INTERMOUNTAIN - MONA 345 KV	1400	-1200	PGE-Bay	50000		WOR -n- Mc-Vic	2592	
INYO - CONTROL 115 KV TIE	56	-56	PV to Devers	4676		WYOMING TO UTAH	1700	
IPP DC LINE	1920	-1400						

2015 Loads and Resources By Area

		2015 Resources		2015 Load			
REGION	**AREA**	**Capacity (1) MW**	**Discounted Capacity (2) MW**	**ANNUAL ENERGY MWh**	**SUMMER PEAK MW (Jul-Aug)**	**WINTER PEAK MW (Dec-Jan)**	**Load Coverage within each SSG-Wi Bubble (using discounted capacity)**
CALIF ("CAISO")	IMPERIAL	2,108	2,092	4,212,776	1,091	501	92%
CALIF ("CAISO")	LADWP (4)	8,983	8,121	33,314,726	6,249	5,060	30%
CALIF ("CAISO")	MEXICO-C	4,717	4,717	15,278,260	3,209	2,405	47%
CALIF ("CAISO")	PG&E_BAY	7,655	7,274	51,987,840	10,919	10,017	-33%
CALIF ("CAISO")	PG&E_VLY (3)	28,680	27,722	79,993,555	19,549	10,870	42%
CALIF ("CAISO")	SANDIEGO	4,923	4,801	22,962,706	5,058	3,912	-5%
CALIF ("CAISO")	SOCALIF (3)	25,766	22,251	134,936,173	25,462	19,491	-13%
AZNMNV	ARIZONA	30,697	30,697	104,761,526	22,626	14,464	36%
AZNMNV	NEVADA (4)	7,582	7,582	29,345,006	7,276	3,648	4%
AZNMNV	NEW MEXI	5,619	5,427	27,245,822	4,730	4,001	15%
AZNMNV	WAPA L.C	6,389	6,389	1,590,561	252	235	2439%
CANADA	ALBERTA	14,482	13,077	77,291,069	10,362	10,794	26%
CANADA	B.C.HYDR	16,058	13,913	74,158,753	9,248	12,457	50%
NWPP	NW_EAST	36,991	31,402	74,310,368	11,270	12,355	179%
NWPP	NW_WEST	12,508	11,778	107,629,066	15,979	17,913	-26%
RMPP	B HILL	1,120	1,120	6,588,272	972	955	15%
RMPP	BHB	0	0	3,695,185	457	506	-100%
RMPP	BONZ	468	468	1,242,519	237	176	97%
RMPP	COL E	13,979	13,227	62,135,625	10,727	9,521	23%
RMPP	COL W	2,294	2,294	6,440,916	951	993	141%
RMPP	IDAHO	2,575	2,217	18,631,181	3,694	2,850	-40%
RMPP	IPP	1,847	1,847	0	1	1	N/A
RMPP	JB	2,628	2,628	0	1	1	N/A
RMPP	KGB	1,476	952	6,826,263	1,429	1,081	-33%
RMPP	LRS	1,628	1,628	3,996,419	581	567	180%
RMPP	MONTANA	5,579	5,062	10,807,468	1,689	1,698	200%
RMPP	SIERRA	4,137	3,656	11,728,413	1,995	1,642	83%
RMPP	SW WYO	964	321	4,553,805	596	547	-46%
RMPP	UT N	2,438	2,438	42,173,311	7,999	5,368	-70%
RMPP	UT S	3,486	3,486	6,057,463	1,189	819	193%
RMPP	WYO	775	775	2,454,859	331	304	134%
RMPP	YLW TL	288	288	0	1	1	N/A
	Total Capacity	**258,838**	**239,648**	**1,026,349,907**	**186,130**	**155,151**	**29% (5)**

(1) Capacity represents installed capacity net of station service (capacity net to the grid).

(2) Discounted capacity reflects the capacity contribution to peak load. The following capacity credits are used for calculating Discounted capacity:

* Assumed discounts: BC Hydro (25% for hydro, 7.5% for wind), NW hydro credit 89.4%, California wind 25%, Colorado wind 10%, all other wind 20%

(3) SOCAL and PG&E VLY loads include irrigation (pump) load obligations, though they are modeled as negative resources to reflect their particular load shapes.

Pump Load obligations SOCAL (6,926.4 Gwh), PGE VLY (4,398.3 Ghw)

(4) LADWP includes 1,446MW of gas generation submitted by NV, but this is shown in the LADWP topology bubble because of dual allocation of the Crystal bus. The 1,446MW was moved from the NV side of the substation to the LADWP side because of bus overloading issues on the NV side.

(5) Represents percentage covered based on discounted capacity only. This percentage (margin) would also need to cover any requirements for operating reserves.

2015 Resources By Area and Fuel Type

		2015 Resources		Resources (Capacity) MW by Fuel Type										
REGION	**AREA**	**Capacity (1) MW**	**Discounted Capacity (2) MW**	**Coal**	**Nat. Gas**	**Oil**	**Hydro**	**Wind**	**DR/DSM**	**Biomass (3) (thermal)**	**Solar**	**Geo**	**Nuclear**	**Other (4)**
CALIF ("CAISO")	IMPERIAL	2,108	2,092	0	357	32	176	21	0	405	0	1,117	0	0
CALIF ("CAISO")	LADWP **(5)**	8,983	8,121	0	6,645	0	1,003	1,150	0	0	185	0	0	0
CALIF ("CAISO")	MEXICO-C	4,717	4,717	0	3,793	139	0	0	0	0	0	785	0	0
CALIF ("CAISO")	PG&E_BAY	7,655	7,274	20	6,076	860	0	508	0	112	0	0	0	80
CALIF ("CAISO")	PG&E_VLY	28,680	27,722	50	14,055	174	8,592	1,278	0	611	280	1,286	2,190	165
CALIF ("CAISO")	SANDIEGO	4,923	4,801	0	4,372	48	40	163	0	0	300	0	0	0
CALIF ("CAISO")	SOCALIF	25,766	22,251	108	15,911	50	1,304	4,687	0	538	660	284	2,150	74
AZNMNV	ARIZONA	30,697	30,697	11,179	15,008	140	233	0	0	0	0	0	4,137	0
AZNMNV	NEVADA (5)	7,582	7,582	605	6,800	0	0	0			0	0	0	177
AZNMNV	NEW MEXI	5,619	5,427	2,037	3,264	0	14	240		64	0	0	0	0
AZNMNV	WAPA L.C	6,389	6,389	400	2,197	0	3,742	0	0	0	50	0	0	0
CANADA	ALBERTA	14,482	13,077	6,767	5,049	0	849	1,756	0	62	0	0	0	0
CANADA	B.C.HYDR	16,058	13,913	0	3,051	0	12,110	897	0	0	0	0	0	0
NWPP	NW_EAST	36,991	31,402	0	4,351	24	27,899	3,283	144	130	0	0	1,160	0
NWPP	NW_WEST	12,508	11,778	1,966	4,548	74	5,067	239	384	230	0	0	0	0
RMPP	B HILL	1,120	1,120	622	317	42	139	0	0	0	0	0	0	0
RMPP	BHB	0	0	0	0	0	0	0	0	0	0	0	0	0
RMPP	BONZ	468	468	468	0	0	0	0	0	0	0	0	0	0
RMPP	COL E	13,979	13,227	6,667	5,569	120	780	835	0	0	8	0	0	0
RMPP	COL W	2,294	2,294	1,904	104	0	286	0	0	0	0	0	0	0
RMPP	IDAHO	2,575	2,217	0	165	0	2,088	170	152	0	0	0	0	0
RMPP	IPP	1,847	1,847	1,847	0	0	0	0	0	0	0	0	0	0
RMPP	JB	2,628	2,628	2,628	0	0	0	0	0	0	0	0	0	0
RMPP	KGB	1,476	952	515	62	0	244	655	0	0	0	0	0	0
RMPP	LRS	1,628	1,628	1,107	300	0	221	0	0	0	0	0	0	0
RMPP	MONTANA	5,579	5,062	3,779	376	0	700	647	0	12	0	0	0	65
RMPP	SIERRA	4,137	3,656	1,268	1,720	0	0	601	0	23	0	524	0	0
RMPP	SW WYO	964	321	0	0	0	160	804	0	0	0	0	0	0
RMPP	UT N	2,438	2,438	929	1,381	0	84	0	44	0	0	0	0	0
RMPP	UT S	3,486	3,486	2,849	613	0	0	0	0	0	0	24	0	0
RMPP	WYO	775	775	775	0	0	0	0	0	0	0	0	0	0
RMPP	YLW TL	288	288	0	0	0	288	0	0	0	0	0	0	0
	Total Capacity	**258,838**	**239,648**	**48,490**	**106,084**	**1,703**	**66,017**	**17,933**	**724**	**2,187**	**1,483**	**4,021**	**9,637**	**561**

(1) Capacity represents installed capacity net of station service (capacity net to the grid).
(2) Discounted capacity reflects the the capacity contribution to peak load.
Assumed Discounts: BC Hydro (25% for hydro, 7.5% for wind), NW hydro credit 89.4%, California wind 25%, Colorado wind 10%, all other wind 20%
(3) Biomass (thermal): includes units using wood as fuel and "urban residuals".
(4) Other: Petroleum coke, waste heat
(5) LADWP includes 1,446MW of gas generation submitted by NV, but in the LADWP topology bubble because of dual allocation of the Crystal bus.
The 1,446MW was moved from the NV side of the substation to the LADWP side because of bus overloading on the NV side.

Over 61,000 MW of nameplate capacity will be added 2004-2015

Sum of PSSEMaxCap(MW)					Year												Nameplate	Discounted
Region Nam	Area Name	Fuel	Timing	Pre-2004	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	TOTAL MW	TOTAL MW
AZNMNV	ARIZONA	Coal	Incr. - 2008				430										430	430
			Incr. - 2015												3,400		3,400	3,400
		Gas	Incr. - 2008		1,134	551	290										1,974	1,974
			Incr. - 2015												2,700		2,700	2,700
		Wind	Incr. - 2015												1,500		1,500	300
	ARIZONA Total			**-**	**1,134**	**551**	**720**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**7,600**	**-**	**10,004**	**8,804**
	NEVADA	Gas	Incr. - 2008		462			664									1,126	1,126
			Incr. - 2015											978	468		1,446	1,446
	NEVADA Total			**-**	**462**	**-**	**-**	**664**	**-**	**-**	**-**	**-**	**-**	**978**	**468**	**-**	**2,572**	**2,572**
	NEW MEXI	Bio	Incr. - 2015							64							64	64
		Gas	Incr. - 2008				614										614	614
			Incr. - 2015				544		412		80		80	290			1,406	1,406
		Gas	Retired - 2008				(149)										(149)	(149)
		Oil	Retired - 2015						(20)								(20)	(20)
	NEW MEXI Total			**-**	**-**	**-**	**1,009**	**-**	**392**	**64**	**80**	**-**	**80**	**290**	**-**	**-**	**1,915**	**1,915**
	WAPA L.C	Coal	Incr. - 2015									400					400	400
		Gas	Incr. - 2008				173										173	173
		Solar	Incr. - 2015												50		50	50
	WAPA L.C Total			**-**	**-**	**-**	**173**	**-**	**-**	**-**	**-**	**400**	**-**	**-**	**50**	**-**	**623**	**623**
AZNMNV Total				**-**	**1,596**	**551**	**1,902**	**664**	**392**	**64**	**80**	**400**	**80**	**1,268**	**8,118**	**-**	**15,114**	**13,914**
CALIF	IMPERIAL	Bio	Incr. - 2008						275								275	275
			Incr. - 2015													75	75	75
		Gas	Incr. - 2015							50							50	50
		Geothermal	Incr. - 2015													425	425	425
	IMPERIAL Total			**-**	**-**	**-**	**-**	**-**	**275**	**50**	**-**	**-**	**-**	**-**	**-**	**500**	**825**	**825**
	LADWP	Gas	Incr. - 2008		484	696			430								1,610	1,610
			Incr. - 2015							150						150	300	300
		Solar	Incr. - 2015												185		185	185
		Wind	Incr. - 2015						650			80		300			1,030	258
	LADWP Total			**-**	**484**	**696**	**-**	**-**	**1,080**	**150**	**-**	**80**	**-**	**300**	**185**	**150**	**3,125**	**2,353**
	MEXICO-C	Gas	Incr. - 2015							233	620		388	233		146	1,619	1,619
		Geothermal	Incr. - 2015								86						86	86
	MEXICO-C	Oil-	Retired - 2015							(300)							(300)	(300)
	MEXICO-C Total			**-**	**-**	**-**	**-**	**-**	**-**	**(68)**	**706**	**-**	**388**	**233**	**-**	**146**	**1,404**	**1,404**
	PG&E_BAY	Bio	Incr. - 2008						100								100	100
		Gas	Incr. - 2008			727		196									923	923
			Incr. - 2015									150	265	150			565	565
		Gas	Retired - 2008					(497)									(497)	(497)
		Wind	Incr. - 2008						50								50	13
	PG&E_BAY Total			**-**	**-**	**727**	**-**	**(301)**	**150**	**-**	**-**	**150**	**265**	**150**	**-**	**-**	**1,141**	**1,104**
	PG&E_VLY	Bio	Incr. - 2015													190	190	190
		Gas	Incr. - 2008			244	803										1,047	1,047
			Incr. - 2015						150	530	150	465	26	415		930	2,666	2,666
		Geothermal	Incr. - 2015													410	410	410
		Solar	Incr. - 2015													280	280	280
		Wind	Incr. - 2015													900	900	225
	PG&E_VLY Total			**-**	**-**	**244**	**803**	**-**	**150**	**530**	**150**	**465**	**26**	**415**	**-**	**2,710**	**5,493**	**4,818**
	SANDIEGO	Gas	Incr. - 2008			49	559	585									1,193	1,193
			Incr. - 2015									500					500	500
			Retired - 2008						(395)								(395)	(395)
		Hydro	Incr. - 2015													40	40	40
		Wind	Incr. - 2015													163	163	41
	SANDIEGO Total			**-**	**-**	**49**	**559**	**585**	**(395)**	**-**	**-**	**500**	**-**	**-**	**-**	**203**	**1,501**	**1,378**
	SOCALIF	Bio	Incr. - 2015													290	290	290
		Gas	Incr. - 2008	5		645	1,112										1,762	1,762
			Incr. - 2015						800			150	150	518	150		1,768	1,768
		Coal	Retired - 2008				(1,580)										(1,580)	(1,580)
		Solar	Incr. - 2015													500	500	500
		Wind	Incr. - 2015													3,500	3,500	875
	SOCALIF Total			**5**	**-**	**645**	**(468)**	**-**	**800**	**-**	**-**	**150**	**150**	**518**	**150**	**4,290**	**6,240**	**3,615**
CAISO Total				***5***	***484***	***2,361***	***894***	***284***	***2,060***	***663***	***856***	***1,345***	***829***	***1,615***	***335***	***7,999***	***19,728***	***15,496***

See next slides for Canada, Northwest and Rocky Mountain regions…

Over 61,000 MW of nameplate capacity will be added 2004-2015

(Continued, 1)

Sum of PSSEMaxCap(MW)					Year												Nameplate	Discounted
Region Name	**Area Name**	**Fuel**	**Timing**	**Pre-2004**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**TOTAL MW**	**TOTAL MW**
CANADA	ALBERTA	Coal	Incr. - 2008			450											450	450
			Incr. - 2015								470	240		240	470		1,420	1,420
			modif-2015	(13)		20											7	7
			Retired - 2008		(134)												(134)	(134)
			Retired - 2015								(300)						(300)	(300)
		Gas	Incr. - 2008		354												354	354
			Retired - 2008				-										-	-
			Retired - 2015							(209)					(150)		(359)	(359)
		Hydro	Retired - 2015											(317)			(317)	(317)
		Wind	Incr. - 2015				420	250	500	250				250			1,670	334
	ALBERTA Total			**(13)**	**220**	**470**	**420**	**250**	**500**	**41**	**170**	**240**	**-**	**173**	**320**	**-**	**2,791**	**1,455**
	B.C.HYDR	Gas	Incr. - 2015					293			180	191			64	445	1,173	1,173
		Hydro	Incr. - 2015								200	1,098		57		399	1,754	439
		Wind	Incr. - 2015									163		82	82	571	897	67
	B.C.HYDR Total			**-**	**-**	**-**	**-**	**293**	**-**	**-**	**380**	**1,452**	**-**	**139**	**146**	**1,414**	**3,823**	**1,678**
CANADA Total				***(13)***	***220***	***470***	***420***	***543***	***500***	***41***	***550***	***1,692***	***-***	***312***	***466***	***1,414***	***6,614***	***3,133***
NWPP	NW_EAST	DSM	Incr. - 2015							144							144	144
		Gas	Incr. - 2008		303			1,280									1,583	1,583
			Incr. - 2015										525	198			723	723
		Hydro	Incr. - 2015										260				260	232
		Wind	Incr. - 2008				225	790	200								1,215	243
			Incr. - 2015						120	130	150	200	190	690	110		1,590	318
	NW_EAST Total			**-**	**303**	**-**	**225**	**2,070**	**320**	**274**	**150**	**200**	**975**	**888**	**110**	**-**	**5,515**	**3,243**
	NW_WEST	DSM	Incr. - 2015					192	192								384	384
		Gas	Incr. - 2008			44											44	44
			Incr. - 2015					390			400						790	790
		Wind	Incr. - 2015									10		120	20		150	30
	NW_WEST Total			**-**	**-**	**44**	**-**	**582**	**192**	**-**	**400**	**10**	**-**	**120**	**20**	**-**	**1,368**	**1,248**
NWPP Total				***-***	***303***	***44***	***225***	***2,652***	***512***	***274***	***550***	***210***	***975***	***1,008***	***130***	***-***	***6,883***	***4,491***

See next slide for Rocky Mountain region…

Over 61,000 MW of nameplate capacity will be added 2004-2015

(Continued,2)

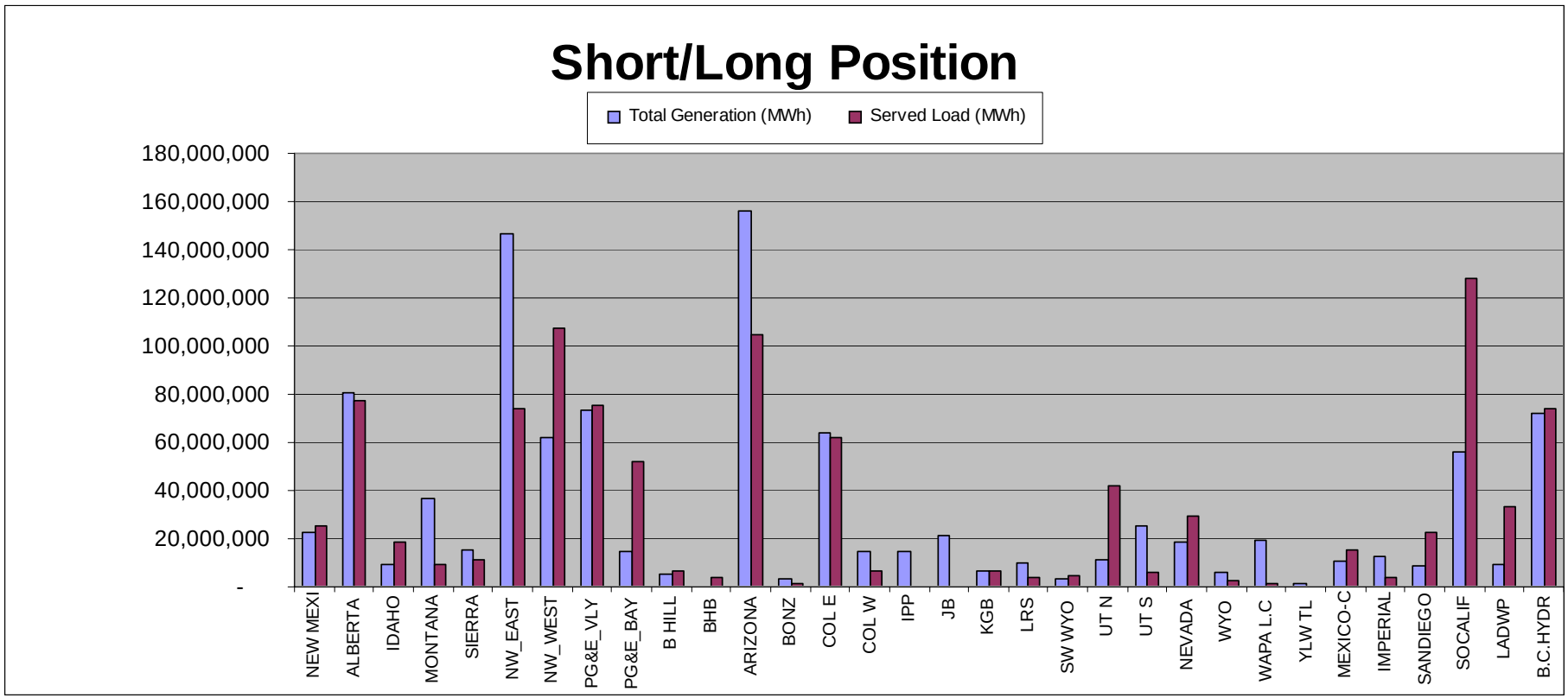
Sum of PSSEMaxCap(MW)					Year												Nameplate	Discounted
Region Name	**Area Name**	**Fuel**	**Timing**	**Pre-2004**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**TOTAL MW**	**TOTAL MW**
RMPP	B HILL	Coal	Incr. - 2015						100								100	100
	B HILL Total			**-**	**-**	**-**	**-**	**-**	**100**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**100**	**100**
	COL E	Coal	Incr. - 2015								750		500	500			1,750	1,750
		Gas	Incr. - 2008		569												569	569
			Incr. - 2015					417	417	368		80					1,282	1,282
		Solar	Incr. - 2015						8								8	8
		Wind	Incr. - 2015			60	75	700									835	167
	COL E Total			**-**	**569**	**60**	**75**	**1,117**	**425**	**368**	**750**	**80**	**500**	**500**	**-**	**-**	**4,444**	**3,693**
	IDAHO	DSM	Incr. - 2015								108	44					152	152
		Gas	Incr. - 2015											30			30	30
		Wind	Incr. - 2008				50	20	100								170	34
	IDAHO Total			**-**	**-**	**-**	**50**	**20**	**100**	**-**	**108**	**44**	**-**	**30**	**-**	**-**	**352**	**216**
	JB	Coal	Incr. - 2015												500		500	500
	JB Total			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**500**	**-**	**500**	**500**
	KGB	Coal	Incr. - 2015											500			500	500
		Gas	Incr. - 2015											62			62	62
		Wind	Incr. - 2008				65										65	13
			Incr. - 2015									20	10	500	60		590	118
	KGB Total			**-**	**-**	**-**	**65**	**-**	**-**	**-**	**-**	**20**	**10**	**1,062**	**60**	**-**	**1,217**	**693**
	MONTANA	Bio	Incr. - 2008					12									12	12
		Coal	Incr. - 2008			119											119	119
			Incr. - 2015						500	268		500					1,268	1,268
		Gas	Incr. - 2008			54		322									376	376
		Hydro	Incr. - 2008		8												8	8
		Wind	Incr. - 2008			197	10		40								247	49
			Incr. - 2015						400								400	80
	MONTANA Total			**-**	**8**	**370**	**10**	**334**	**940**	**268**	**-**	**500**	**-**	**-**	**-**	**-**	**2,430**	**1,912**
RMPP	SIERRA	Coal	Incr. - 2015						203			500					703	703
		Gas	Incr. - 2015						514								514	514
		Geothermal	Incr. - 2015				10	25	10			104		190	102		441	441
		Wind	Incr. - 2015				130					260			211		601	120
	SIERRA Total			**-**	**-**	**-**	**140**	**25**	**727**	**-**	**-**	**864**	**-**	**190**	**313**	**-**	**2,259**	**1,778**
	SW WYO	Wind	Incr. - 2015											-		700	700	140
	SW WYO			**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**700**	**700**	**140**
	UT N	Gas	Incr. - 2008						547								547	547
	UT N	Gas	Retired - 2008					(116)									(116)	(116)
			Retired - 2015						(64)								(64)	(64)
	UT N Total			**-**	**-**	**-**	**-**	**(116)**	**483**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**367**	**367**
	UT S	Coal	Incr. - 2015										575				575	575
		Gas	Incr. - 2008			270	233										503	503
	UT S Total			**-**	**-**	**270**	**233**	**-**	**-**	**-**	**-**	**-**	**575**	**-**	**-**	**-**	**1,078**	**1,078**
RMPP Total				***-***	***577***	***700***	***573***	***1,380***	***2,775***	***636***	***858***	***1,508***	***1,085***	***1,782***	***873***	***700***	***13,447***	***10,477***
Total Net Increase/(Decrease) MW				**(8)**	**3,180**	**4,125**	**4,014**	**5,523**	**6,239**	**1,678**	**2,894**	**5,155**	**2,969**	**5,985**	**9,922**	**10,113**	**61,786**	**47,511**

2015 Reference Case Results

SSGwi
Seams Steering Group of the Western Interconnection

Annual Generation and Load Served by Area

$5 Gas (HH in $2005)



Capacity Factors Under Different Gas Price Scenarios

By Region and Technology Type

$5 Henry Hub - All Hours			Coal/Bio/Oil/Gas								
Region	CCCT	SCCT	ST	Int. Comb.	Nuclear	GEO	Hydro	Wind	Solar	DSM	Total for Region
AZNMNV	32%	1%	70%		93%		42%	29%	22%		48%
CA *	34%	1%	13%		93%	81%	38%	24%	22%		29%
CANADA	33%	26%	86%				55%	40%			56%
NWPP	76%	15%	82%	0%	93%		42%	34%			48%
RMPP	27%	14%	85%			92%	46%	39%	20%	0%	62%
Total for Category	**39%**	**7%**	**64%**	**0%**	**93%**	**82%**	**44%**	**31%**	**22%**	**0%**	**45%**

$7 Henry Hub - All Hours			Coal/Bio/Oil/Gas								
Region	CCCT	SCCT	ST	Int. Comb.	Nuclear	GEO	Hydro	Wind	Solar	DSM	Total for Region
AZNMNV	31%	1%	70%		93%		42%	29%	22%		48%
CA *	34%	1%	15%		93%	81%	38%	24%	22%		29%
CANADA	30%	27%	86%				55%	40%			56%
NWPP	72%	13%	83%	0%	93%		42%	34%			48%
RMPP	28%	14%	85%			92%	46%	39%	20%	0%	62%
Total for Category	**38%**	**7%**	**65%**	**0%**	**93%**	**82%**	**44%**	**31%**	**22%**	**0%**	**45%**

$9 Henry Hub - All Hours			Coal/Bio/Oil/Gas								
Region	CCCT	SCCT	ST	Int. Comb.	Nuclear	GEO	Hydro	Wind	Solar	DSM	Total for Region
AZNMNV	29%	1%	69%	12%	93%		42%	29%	22%		47%
CA *	34%	2%	17%		93%	81%	38%	24%	22%		30%
CANADA	28%	27%	86%	0%			55%	40%			56%
NWPP	69%	14%	83%	7%	93%		42%	34%			47%
RMPP	27%	14%	85%			92%	46%	39%	20%	0%	62%
Total for Category	**37%**	**8%**	**65%**	**7%**	**93%**	**82%**	**44%**	**31%**	**22%**	**0%**	**45%**

* CA Steam Turbine (ST) capacity factors are low because most ST resources in CA are biomass and oil. These non-coal units tend to be smaller and less efficient.

Arguably, the Reference Case includes too many resources (29 percent planning margin for West after capacity discounts and assuming average hydro conditions). This leads to low capacity factors for thermal units, as reflected in the combined cycle (CCCT) and steam turbine (ST) technology columns. For example, of the 1,500MW of new 50MW gas-fired SCCTs added in AZ, none dispatched in any of the three price scenarios.

Capacity Factors Under Different Gas Price Scenarios (Cont'd)

By Region and Technology Type – Peak Hours Only

$5 Henry Hub - Peak Hours *Coal/Bio/Oil/Gas*

Region	CCCT	SCCT	ST	Int. Comb.	Nuclear	GEO	Hydro	Wind	Solar	DSM	Total for Region
AZNMNV	36%	1%	70%		93%		51%	31%	28%		50%
CA	37%	1%	13%		93%	80%	44%	25%	29%		30%
CANADA	36%	29%	87%				58%	38%			58%
NWPP	77%	16%	82%	0%	93%		45%	31%			50%
RMPP	31%	15%	85%			92%	56%	39%	26%	0%	64%
Total for Category	**42%**	**8%**	**64%**	**0%**	**93%**	**82%**	**49%**	**31%**	**29%**	**0%**	**47%**

$7 Henry Hub - Peak Hours *Coal/Bio/Oil/Gas*

Region	CCCT	SCCT	ST	Int. Comb.	Nuclear	GEO	Hydro	Wind	Solar	DSM	Total for Region
AZNMNV	35%	1%	70%		93%		51%	31%	28%		50%
CA	37%	1%	16%		93%	80%	44%	25%	29%		31%
CANADA	34%	30%	87%				58%	38%			58%
NWPP	74%	14%	83%	0%	93%		45%	31%			50%
RMPP	32%	15%	85%			92%	56%	39%	26%	0%	64%
Total for Category	**41%**	**8%**	**65%**	**0%**	**93%**	**82%**	**49%**	**31%**	**29%**	**0%**	**47%**

$9 Henry Hub - Peak Hours *Coal/Bio/Oil/Gas*

Region	CCCT	SCCT	ST	Int. Comb.	Nuclear	GEO	Hydro	Wind	Solar	DSM	Total for Region
AZNMNV	33%	1%	70%	13%	93%		51%	31%	28%		49%
CA	37%	2%	18%		93%	80%	44%	25%	29%		31%
CANADA	32%	29%	87%	0%			58%	38%			58%
NWPP	71%	15%	83%	7%	93%		45%	31%			50%
RMPP	31%	15%	85%			92%	56%	39%	26%	0%	64%
Total for Category	**40%**	**8%**	**66%**	**8%**	**93%**	**82%**	**49%**	**31%**	**29%**	**0%**	**47%**

Capacity Factors for Gas-Fired Units

By Region and Technology Type (All Hours - 8760)

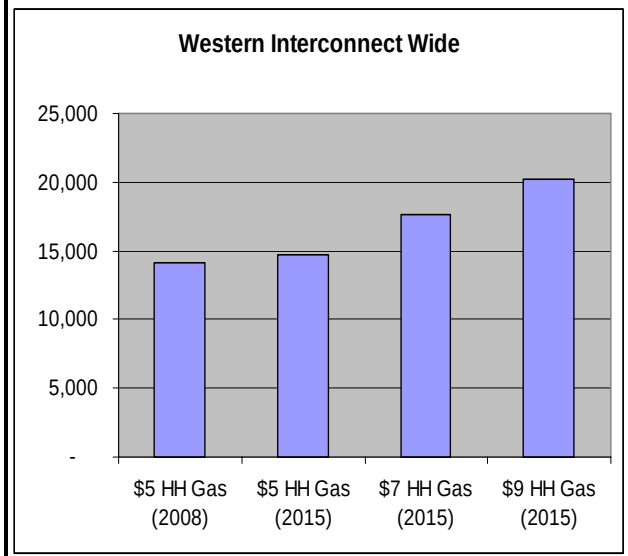
Capacity Factors, Gas-fired units																
	Bucket	6	9	10	12	26	27	5	7	8	25	28	1	2	3	4
$5 HH Gas	Fuel	Gas	Gas	Gas/Oil	Gas	Gas/Oil	Gas	Gas	Gas	Gas	Gas	Gas	Gas/Oil	Gas/Oil	Gas/Oil	Gas/Oil
	Technology	CCCT	CCCT	CCCT- Frame F	CCCT+DF	CCCT- Frame G	CCG+H	SCCT	SCCT	SCCT	SCCT	GTC 28	ST	ST	ST	ST
	Size					>450 MW			<70 MW	>=70 MW			<100 MW	>=100 MW	<100 MW	>=100 MW
	Vintage	<1985	>=1985 & <2001	>=2001	>=1985	>=2008	>=2005	<1985	>=1985 & <2006	>=1985 & <2006	>=2006	>=2005	<1960	<1960	>=1960	>=1960
ALL HOURS																
Region	**Area**															
AZNMNV	ARIZONA	1%		49%	2%					14%					1%	25%
	NEVADA		73%	22%						2%						
	NEW MEXI			28%	5%	44%			3%	8%	2%				1%	14%
	WAPA L.C			19%	2%				1%							
AZNMNV Total		**0.4%**	**73%**	**39%**	**3%**	**44%**	**0%**	**0.0%**	**0.4%**	**7%**	**2%**	**0%**	**0.0%**	**0.2%**	**0.5%**	**22%**
CAISO	IMPERIAL		72%												0%	
	LADWP	0%		26%		93%			0%		3%				0%	12%
	MEXICO-C	2%		34%						1%	2%					5%
	PG&E_BAY		63%	23%		91%			0%		4%				0%	1%
	PG&E_VLY		53%	18%	1%	75%			0%		2%		0%		0%	3%
	SANDIEGO		65%	18%		92%			0%							0%
	SOCALIF	5%	66%	27%	1%	93%			0%	3%	4%		23%		9%	3%
CAISO Total		**3%**	**61%**	**24%**	**1%**	**86%**	**0%**	**0%**	**0.4%**	**2%**	**3%**	**0%**	**6%**	**0%**	**3%**	**4%**
CANADA	ALBERTA	1%	59%	32%	20%		74%		12%	20%		63%			6%	25%
	B.C.HYDR	1%		57%		25%			20%	41%					4%	40%
CANADA Total		**1%**	**59%**	**46%**	**20%**	**25%**	**74%**		**13%**	**25%**		**63%**			**4%**	**35%**
NWPP	NW_EAST		86%	74%	26%	93%		6%	27%		30%			4%		
	NW_WEST	7%	83%	57%	30%	92%		12%	29%							
NWPP Total		**7%**	**84%**	**67%**	**26%**	**93%**		**12%**	**28%**		**30%**			**4%**		
RMPP	B HILL															
	COL E		31%	7%	2%				1%	10%	4%					
	COL W		13%													
	IDAHO										20%					
	KGB															
	LRS															
	MONTANA										10%					
	SIERRA															
	UT N								1%							
	UT S															
RMPP Total		**0%**	**22%**	**0%**	**0%**	**0%**	**0%**	**0%**	**4%**	**0%**	**0%**	**0%**	**0%**	**1%**	**0%**	**0%**
Grand Total		**2%**	**66%**	**34%**	**4%**	**80%**	**74%**	**2%**	**3%**	**9%**	**4%**	**63%**	**2%**	**0%**	**3%**	**6%**

Production Costs

Annual Fuel and Other Variable O&M (M$)

ID	Region	Area	2008		2015 Reference Case	
			Base Case			
			$5 HH Gas	$5 HH Gas	$7 HH Gas	$9 HH Gas
1	AZNMNV	ARIZONA	2,410	2,851	3,126	3,243
2		NEVADA	727	602	860	1,152
3		NEW MEXI	352	506	557	604
4		WAPA L.C	116	175	246	338
5	CAISO	IMPERIAL	109	111	129	161
6		LADWP	500	237	316	409
7		MEXICO-C	181	362	471	629
8		PG&E_BAY	863	566	853	1,038
9		PG&E_VLY	1,181	817	1,066	1,359
10		SANDIEGO	239	320	417	550
11		SOCALIF	843	954	1,259	1,526
12	CANADA	ALBERTA	1,467	1,639	1,787	1,909
13		B.C.HYDR	135	245	304	361
14	NWPP	NW_EAST	879	1,023	1,351	1,619
15		NW_WEST	1,183	1,314	1,616	1,934
16	RMPP	B HILL	60	56	57	57
17		BHB	-	-	-	-
18		BONZ	45	47	47	47
19		COL E	856	906	972	1,026
20		COL W	230	221	224	226
21		IDAHO	9	4	6	8
22		IPP	216	215	215	215
23		JB	227	278	278	278
24		KGB	2	62	64	66
25		LRS	72	68	68	68
26		MONTANA	304	299	315	336
27		SIERRA	101	181	185	188
28		SW WYO	-	-	-	-
29		UT N	353	263	319	375
30		UT S	401	407	440	472
31		WYO	48	48	48	48
32		YLW TL	-	-	-	-
	Total		14,110	14,778	**17,594**	20,242

(2005 dollars)



Two Methods of Calculating Congestion Costs

(2015 Annual Summary)

Method I: In the shadow price X MW flow columns, congestion cost for each congested path is defined as the hourly shadow price for each congested hour times the flow on the path for that hour, with the results summed for the year.

Method II: Shadow price is the production cost decrease if 1 MW limit of the constraint is relaxed.

Interface Name	Method I (Shadow Price X MW Flow) ($000)			Rank			Method II *See next slide for more details* Shadow Price ($/MW) (Annual Average)			Rank		
	$5G	$7G	$9G	$5G	$7G	$9G	$5G	$7G	$9G	$5G	$7G	$9G
ALBERTA - BRITISH COLUMBIA	34,199	52,048	69,270	10	11	10	5.57	8.49	11.29	7	7	7
BONANZA WEST	128,592	193,862	260,621	3	3	3	18.93	28.19	37.90	1	1	1
BORAH WEST	32,490	53,503	79,154	11	10	8	1.43	2.39	3.53	18	16	14
BRIDGER WEST	36,955	56,449	73,984	9	9	9	1.93	2.93	3.84	16	12	12
BROWNLEE EAST	847	950	1,041	29	30	29	0.05	0.06	0.06	30	30	29
COI	93,035	77,532	68,445	5	8	11	2.25	1.88	1.66	12	19	21
HA-Red Butte PS	5,030	6,865	9,252	19	20	20	2.04	2.61	3.52	13	14	15
Hassayampa - N. Gila	4,988	3,371	812	20	25	30	0.45	0.20	0.05	25	28	30
IDAHO - SIERRA	1,976	4,049	6,136	25	23	22	0.62	1.28	1.95	22	21	19
IPP DC LINE	117,109	172,445	227,726	4	4	4	6.86	10.25	13.54	5	6	6
MONTANA - NORTHWEST	209,839	334,400	491,453	2	2	2	8.22	12.94	19.02	4	4	4
NORTHWEST - CANADA	1,060	1,525	2,224	28	29	26	0.06	0.09	0.13	29	29	28
NW to Canada East BC	7,110	9,461	12,600	17	17	19	1.98	2.69	3.59	15	13	13
PACIFIC DC INTERTIE (PDCI)	86,728	103,170	117,562	6	6	6	3.47	4.21	4.79	10	10	11
PACIFICORP_PG&E 115 KV INTERCON.	2,016	1,867	1,788	24	27	28	2.68	2.53	2.44	11	15	18
Path 45	3,914	5,725	5,905	23	22	23	0.78	0.82	0.86	21	23	24
PATH C	4,610	6,365	8,802	22	21	21	0.61	0.86	1.19	23	22	23
PAVANT INTRMTN - GONDER 230 KV	14,015	23,201	31,702	13	12	13	6.76	11.27	15.40	6	5	5
SOUTHERN NEW MEXICO (NM1)	9,462	18,665	28,457	16	15	14	1.02	2.03	3.10	19	18	17
SOUTHWEST OF FOUR CORNERS	717,209	1,117,571	1,504,644	1	1	1	15.60	23.96	32.26	2	2	2
TOT 1A	6,846	9,158	12,985	18	18	17	0.96	1.31	1.85	20	20	20
TOT 2A	76,727	129,341	177,936	7	5	5	12.25	21.40	29.44	3	3	3
Tot 2a 2b 2c Nomogram	1,357	3,414	4,815	27	24	24	0.09	0.25	0.35	28	27	26
TOT 2B2	4,929	9,095	12,684	21	19	18	2.01	3.92	5.46	14	11	10
TOT 2C	13,531	20,724	27,313	14	14	15	4.99	7.89	10.39	8	8	8
TOT 4A	10,252	15,543	24,952	15	16	16	1.57	2.19	3.52	17	17	16
TOT 4B	567	1,547	2,056	30	28	27	0.10	0.26	0.35	27	26	27
TOT 7	1,902	3,070	3,752	26	26	25	0.20	0.39	0.48	26	25	25
WEST OF BROADVIEW	14,280	21,085	39,050	12	13	12	0.52	0.72	1.34	24	24	22
WYOMING TO UTAH	57,250	81,758	107,017	8	7	7	3.87	5.49	7.19	9	9	9

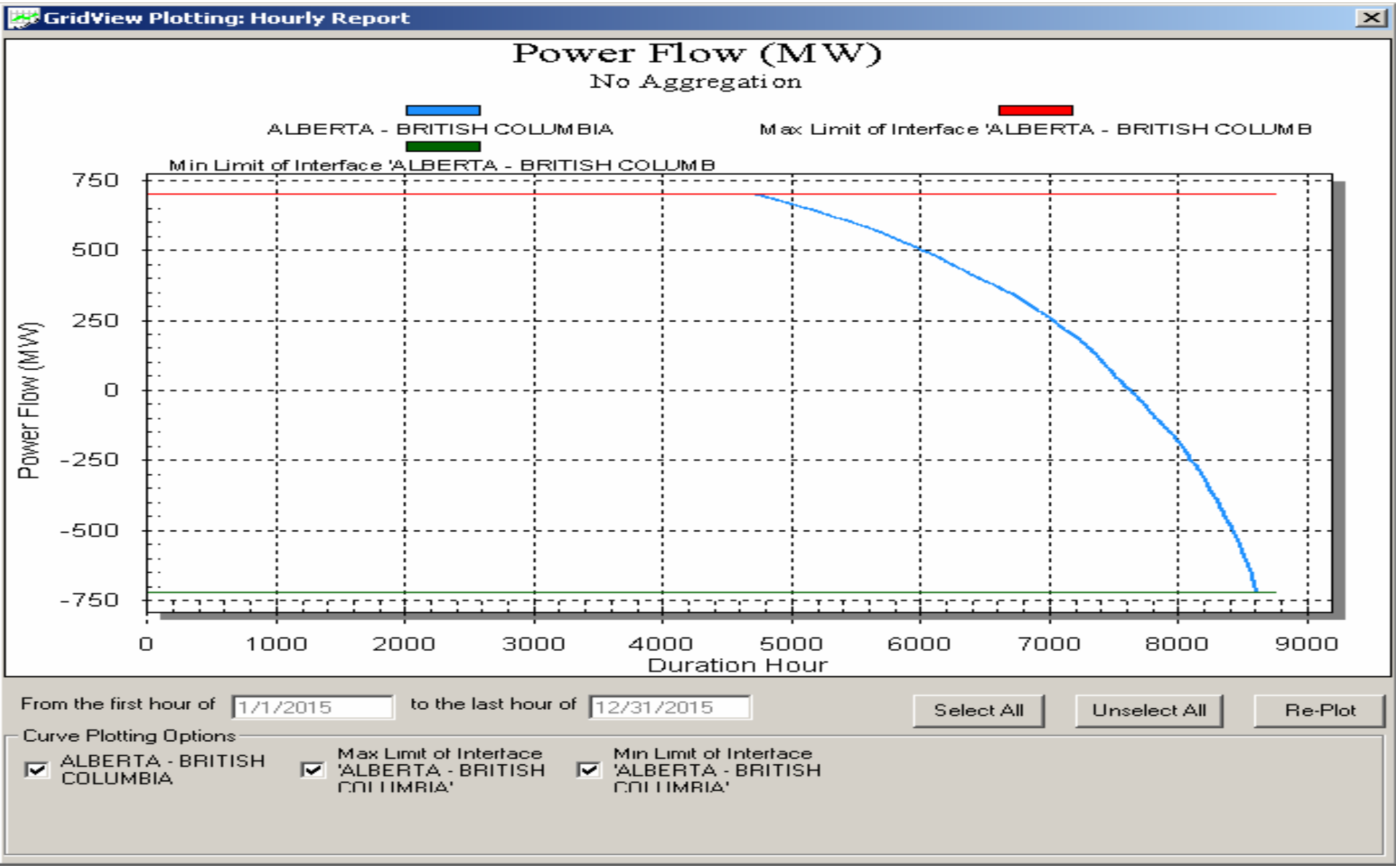
Method II for Calculating Congestion Costs

(2015 Annual Summary)

Shadow Price $/MW

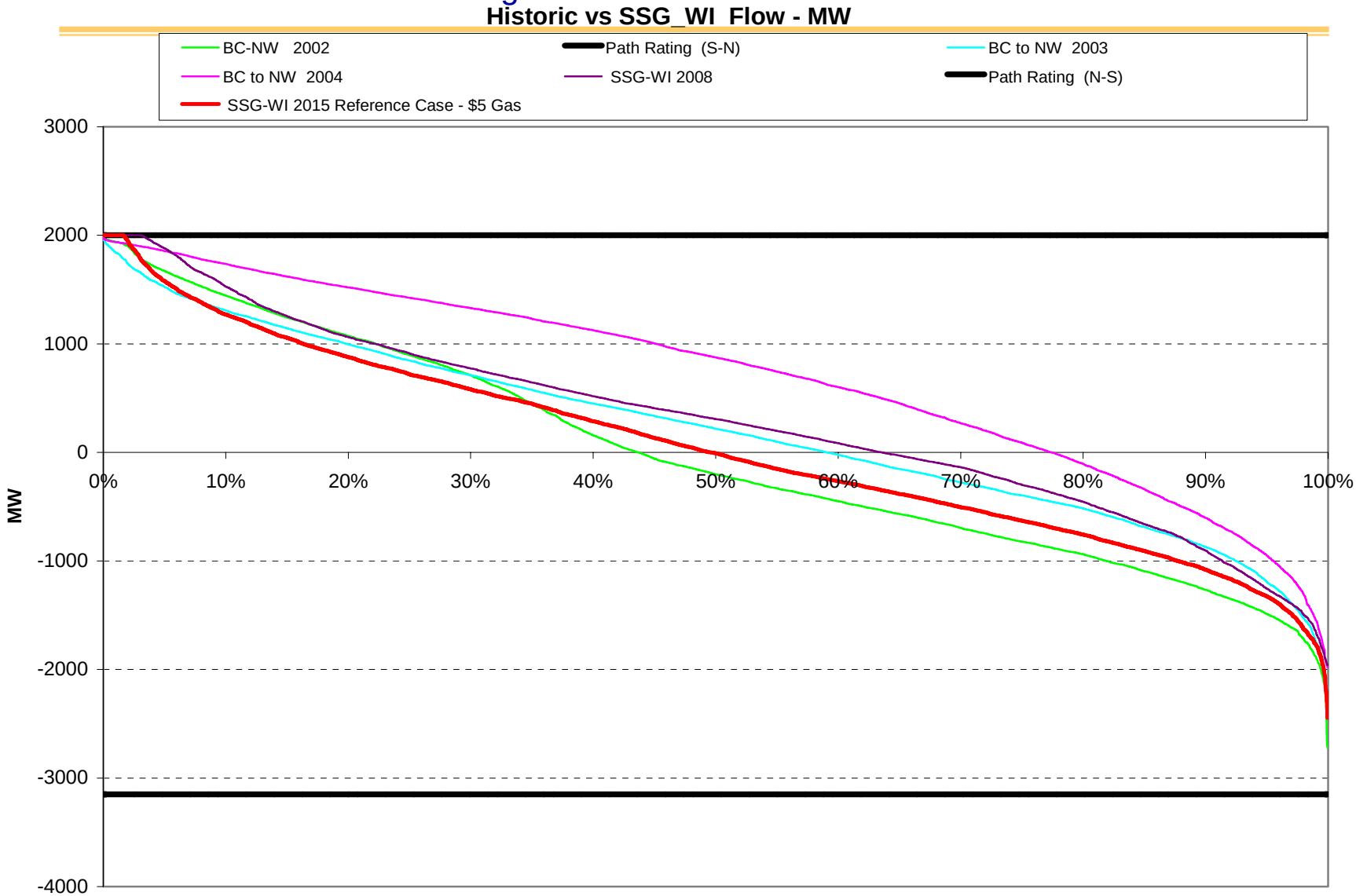
	Rank Based on Average Shadow Price			$5 Gas Shadow Price Details				$7 Gas Shadow Price Details				$9 Gas Shadow Price Details			
CONGESTED PATH	$5 Gas	$7 Gas	$9 Gas	Average Shadow Price (SP)	Max (SP)	Min (SP)	Hours of non Zero SP	Average Shadow Price (SP)	Max (SP)	Min (SP)	Hours of non Zero SP	Average Shadow Price (SP)	Max (SP)	Min (SP)	Hours of non Zero SP
ALBERTA - BRITISH COLUMBIA	7	7	7	5.57	348.14	(254.21)	4,834	8.49	125.29	(347.23)	4,796	11.29	246.49	(338.09)	4,385
BONANZA WEST	1	1	1	18.93	-	(62.31)	5,769	28.19	-	(92.81)	5,783	37.90	-	(120.33)	5,778
BORAH WEST	18	16	14	1.43	-	(45.73)	722	2.39	-	(68.04)	775	3.53	-	(91.17)	832
BRIDGER WEST	16	12	12	1.93	-	(46.37)	1,401	2.93	-	(69.11)	1,395	3.84	-	(84.74)	1,291
BROWNLEE EAST	30	30	29	0.05	-	(28.67)	31	0.06	-	(36.32)	25	0.06	-	(61.04)	26
COI	12	19	21	2.25	-	(19.38)	4,345	1.88	-	(22.52)	3,335	1.66	-	(33.93)	2,719
HA-Red Butte PS	13	14	15	2.04	-	(33.02)	2,945	2.61	-	(52.43)	2,664	3.52	-	(71.32)	2,632
Hassayampa - N. Gila	25	28	30	0.45	-	(6.24)	1,681	0.20	-	(17.81)	1,129	0.05	-	(8.96)	452
IDAHO - SIERRA	22	21	19	0.62	38.91	(0.45)	307	1.28	65.27	-	375	1.95	101.08	-	428
IPP DC LINE	5	6	6	6.86	-	(34.07)	6,317	10.25	-	(54.10)	6,360	13.54	-	(69.62)	6,349
MONTANA - NORTHWEST	4	4	4	8.22	-	(48.76)	4,225	12.94	-	(71.07)	4,567	19.02	-	(93.44)	5,006
NORTHWEST - CANADA	29	30	29	0.06	-	(10.10)	149	0.09	-	(16.21)	153	0.13	-	(19.21)	168
NW to Canada East BC	15	13	13	1.98	-	(742.59)	3,303	2.69	-	(1,000.00)	3,463	3.59	-	(1,000.00)	3,334
PACIFIC DC INTERTIE (PDCI)	10	10	11	3.47	-	(20.45)	7,547	4.21	-	(21.93)	7,576	4.79	-	(32.13)	7,427
PACIFICORP_PG&E 115 KV INTERCON.	11	15	18	2.68	0.03	(19.73)	8,179	2.53	1.24	(22.86)	7,885	2.44	2.03	(33.45)	7,622
Path 45	21	23	24	0.78	22.80	(2.69)	2,912	0.82	36.42	(2.73)	2,683	0.86	54.92	(6.76)	2,342
PATH C	23	22	23	0.61	53.72	(14.15)	552	0.86	69.87	(37.52)	542	1.19	100.43	(58.91)	611
PAVANT INTRMTN - GONDER 230 KV	6	5	5	6.76	74.08	-	2,627	11.27	120.37	-	2,669	15.40	165.91	-	2,629
SOUTHERN NEW MEXICO (NM1)	19	18	17	1.02	-	(12.38)	2,451	2.03	-	(19.50)	2,783	3.10	-	(28.72)	2,989
SOUTHWEST OF FOUR CORNERS	2	2	2	15.60	-	(40.27)	6,370	23.96	-	(63.16)	6,343	32.26	-	(85.56)	6,282
TOT 1A	20	20	20	0.96	-	(48.15)	1,203	1.31	-	(73.99)	1,205	1.85	-	(93.77)	1,385
TOT 2A	3	3	3	12.25	-	(72.54)	4,831	21.40	-	(111.52)	5,525	29.44	-	(148.98)	5,662
Tot 2a 2b 2c Nomogram	28	28	26	0.09	-	(25.00)	125	0.25	-	(39.66)	207	0.35	-	(49.98)	238
TOT 2B2	14	11	10	2.01	-	(160.69)	542	3.92	-	(237.80)	687	5.46	-	(272.86)	720
TOT 2C	8	8	8	4.99	6.91	(35.48)	5,337	7.89	-	(56.72)	5,573	10.39	-	(73.22)	5,649
TOT 4A	17	17	16	1.57	-	(51.29)	679	2.19	-	(70.87)	642	3.52	-	(83.88)	859
TOT 4B	27	27	27	0.10	-	(27.80)	51	0.26	-	(41.52)	76	0.35	-	(57.90)	79
TOT 7	26	25	25	0.20	-	(47.20)	126	0.39	-	(67.12)	143	0.48	-	(80.75)	133
WEST OF BROADVIEW	24	24	22	0.52	-	(21.85)	703	0.72	-	(32.78)	670	1.34	-	(43.55)	939
WYOMING TO UTAH	9	9	9	3.87	-	(32.66)	6,057	5.49	-	(48.36)	6,016	7.19	-	(62.15)	6,065

Alberta – British Columbia



Northwest to Canada

Washington and southern British Columbia

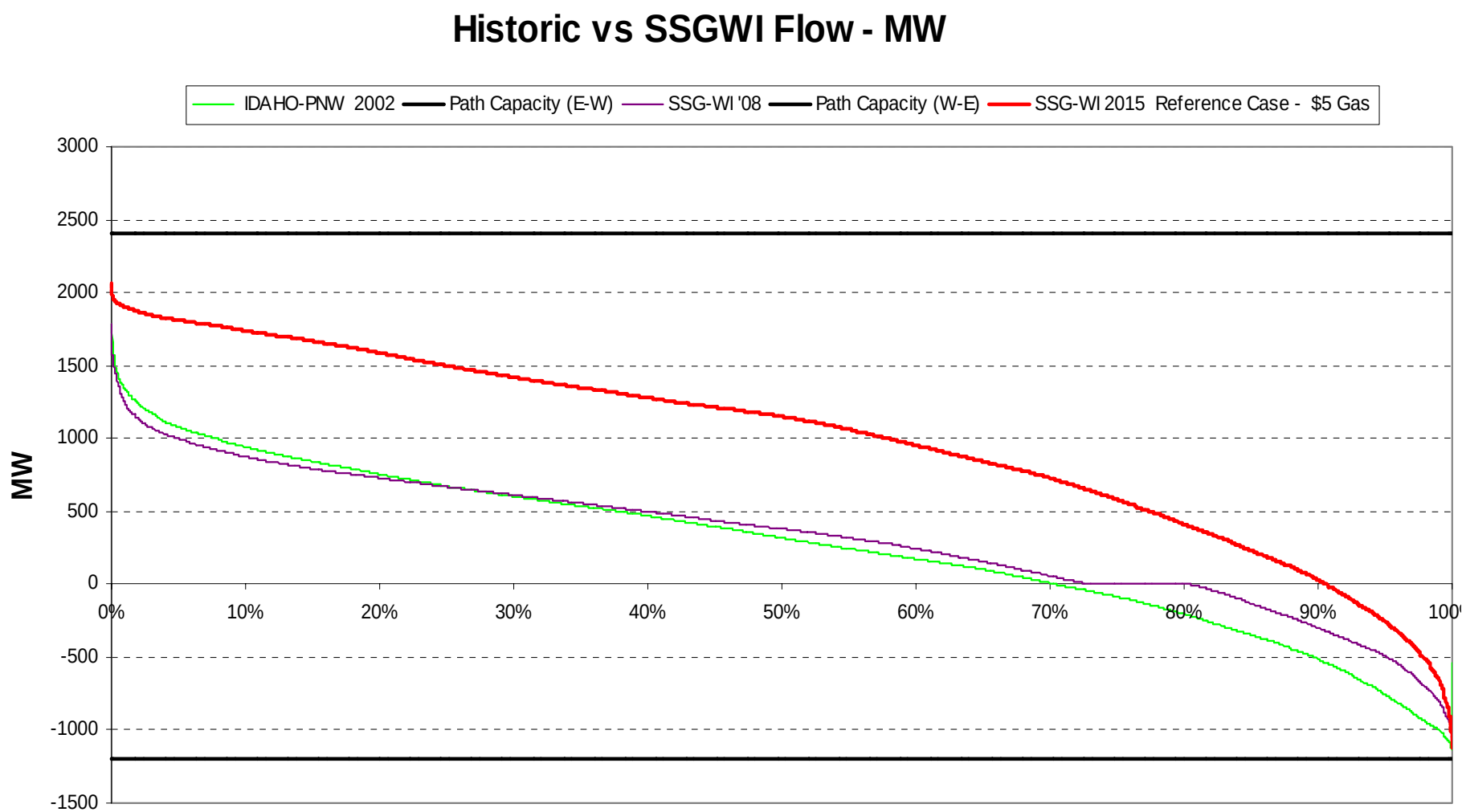


2015 IRP-RPS Reference Case

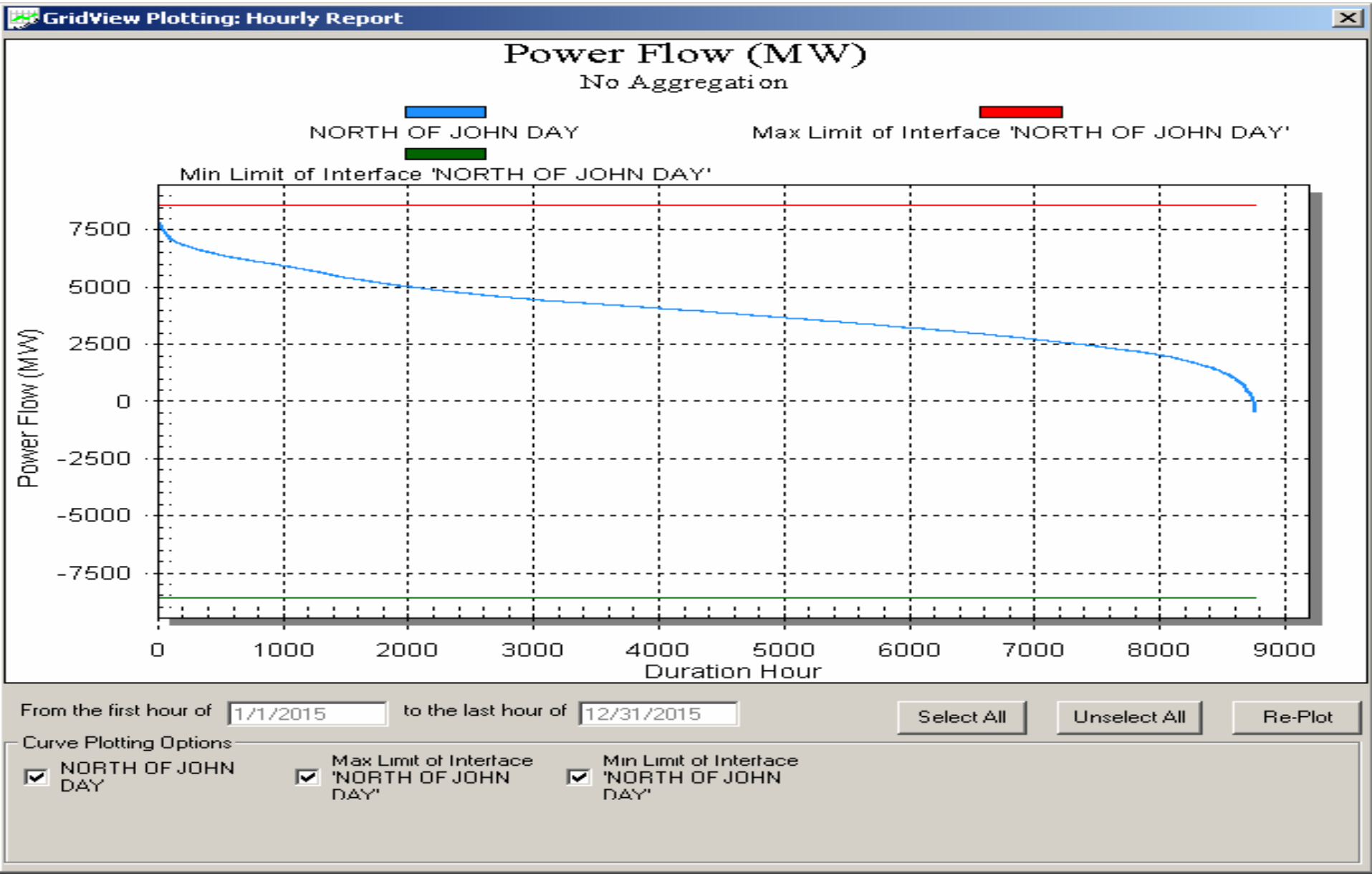
January 30, 2006

Idaho to PNW Duration Curve

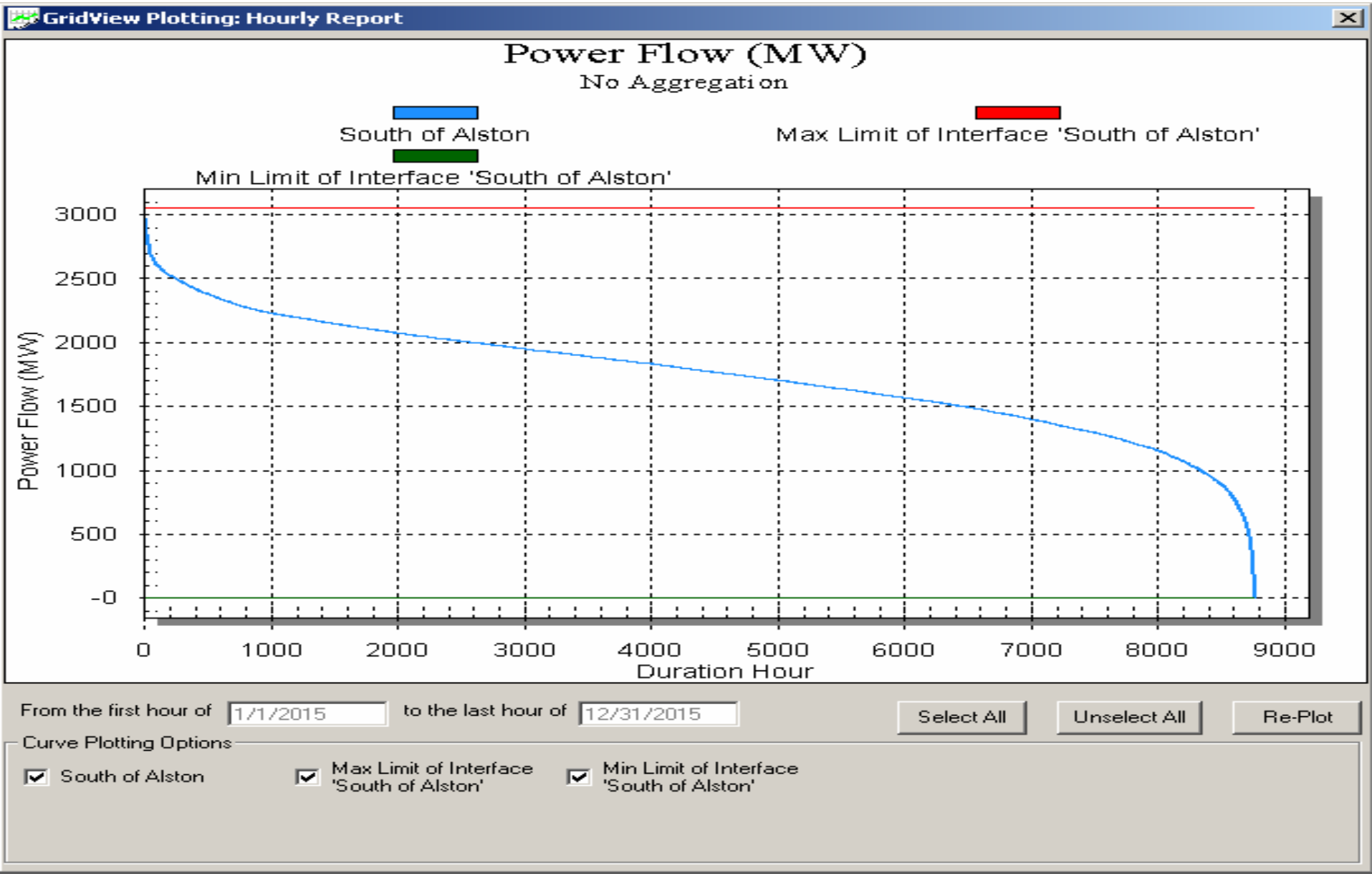
Southwest Idaho and Eastern Oregon/Washington and Northern Idaho



North of John Day

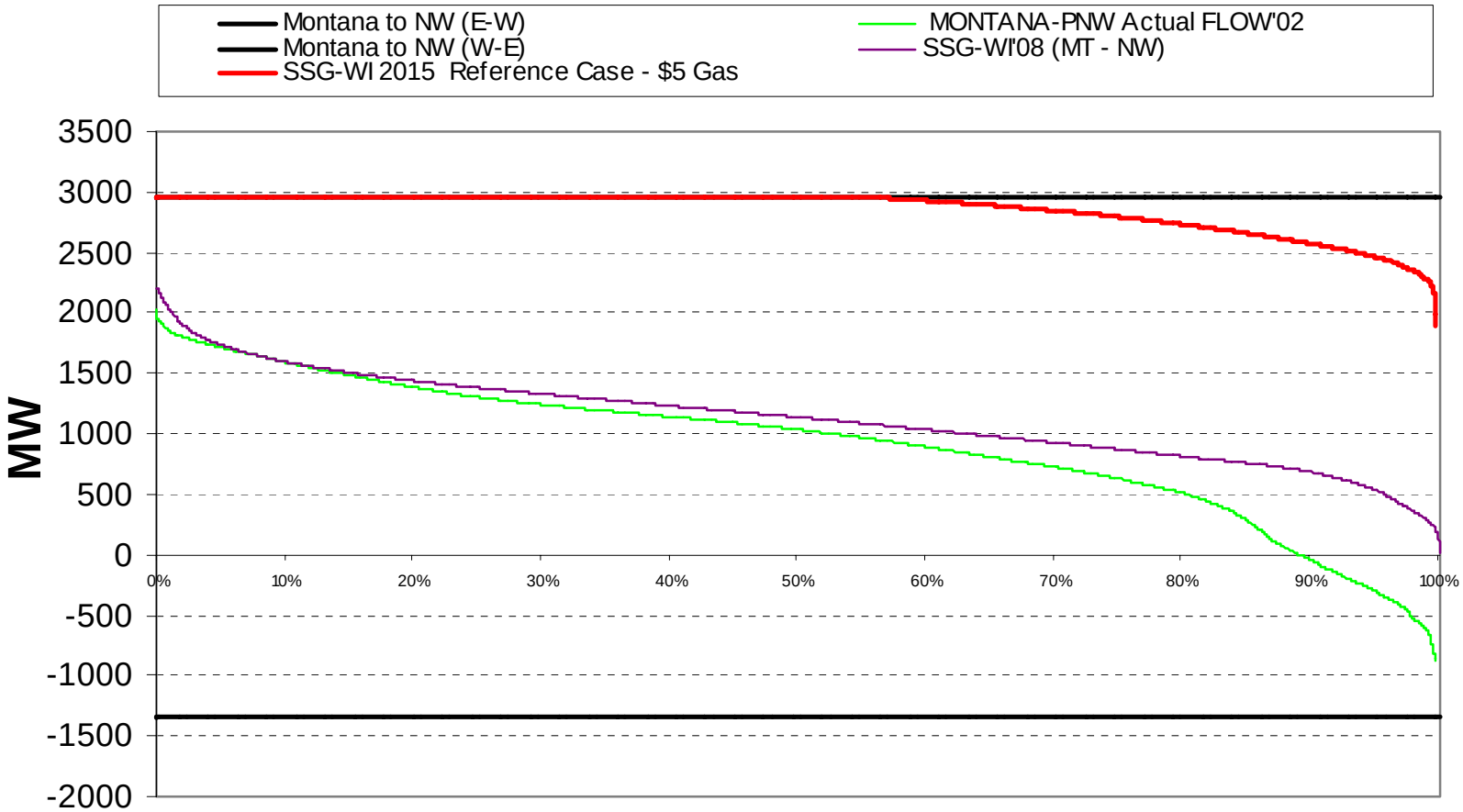


South of Alston

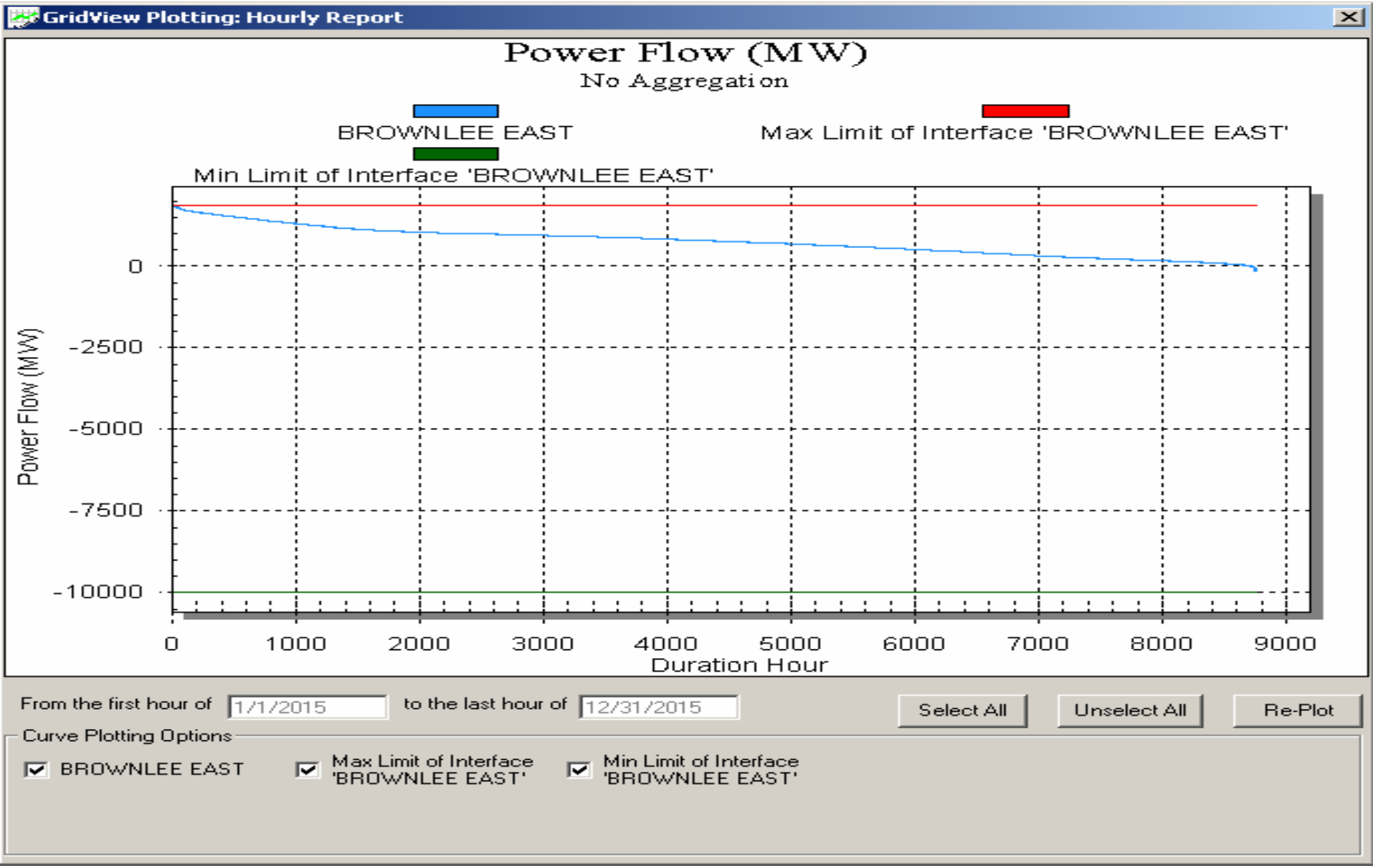


Montana to PNW Duration Curve

Historic vs SSGWI - MW

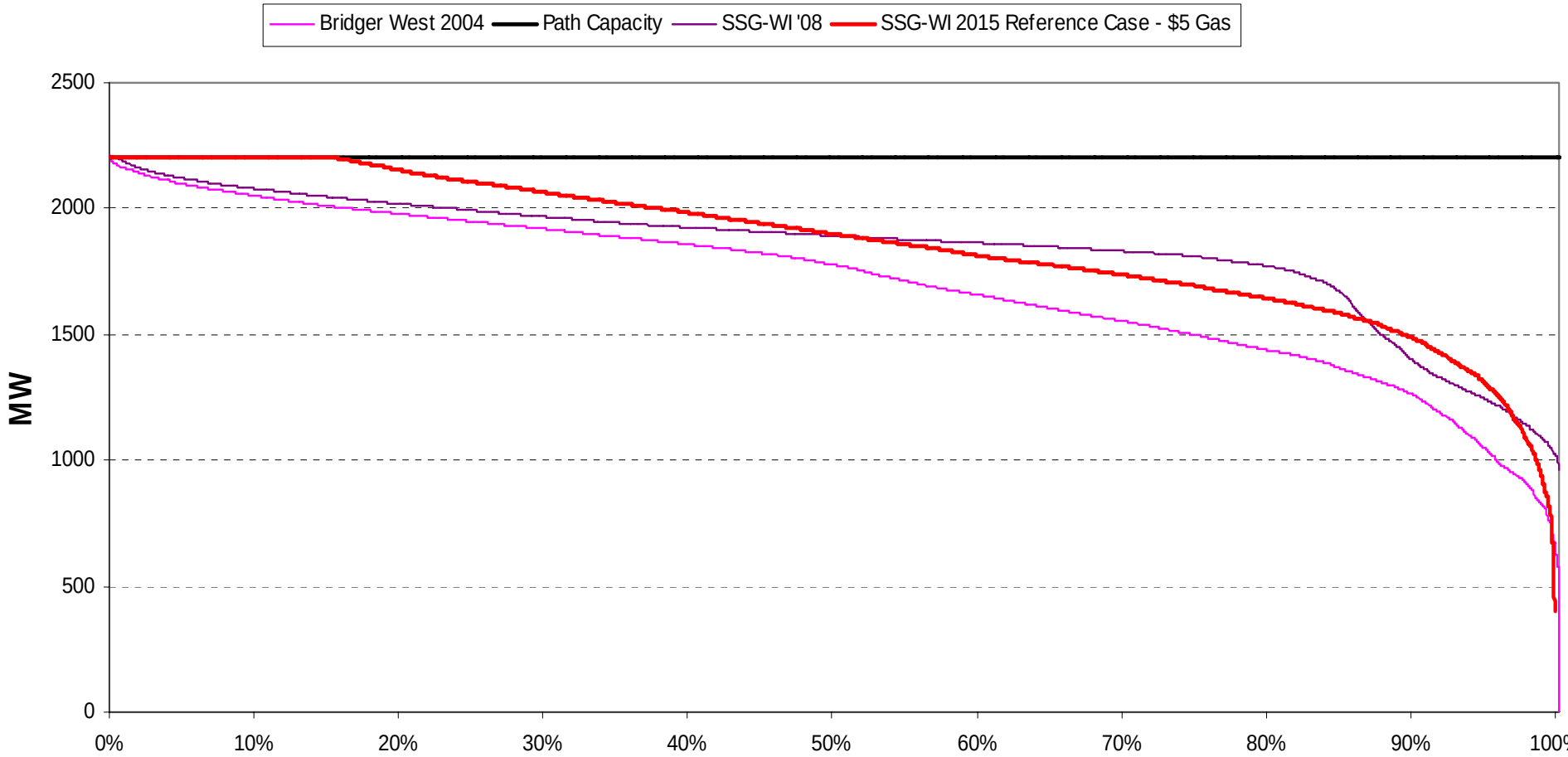


Brownlee East



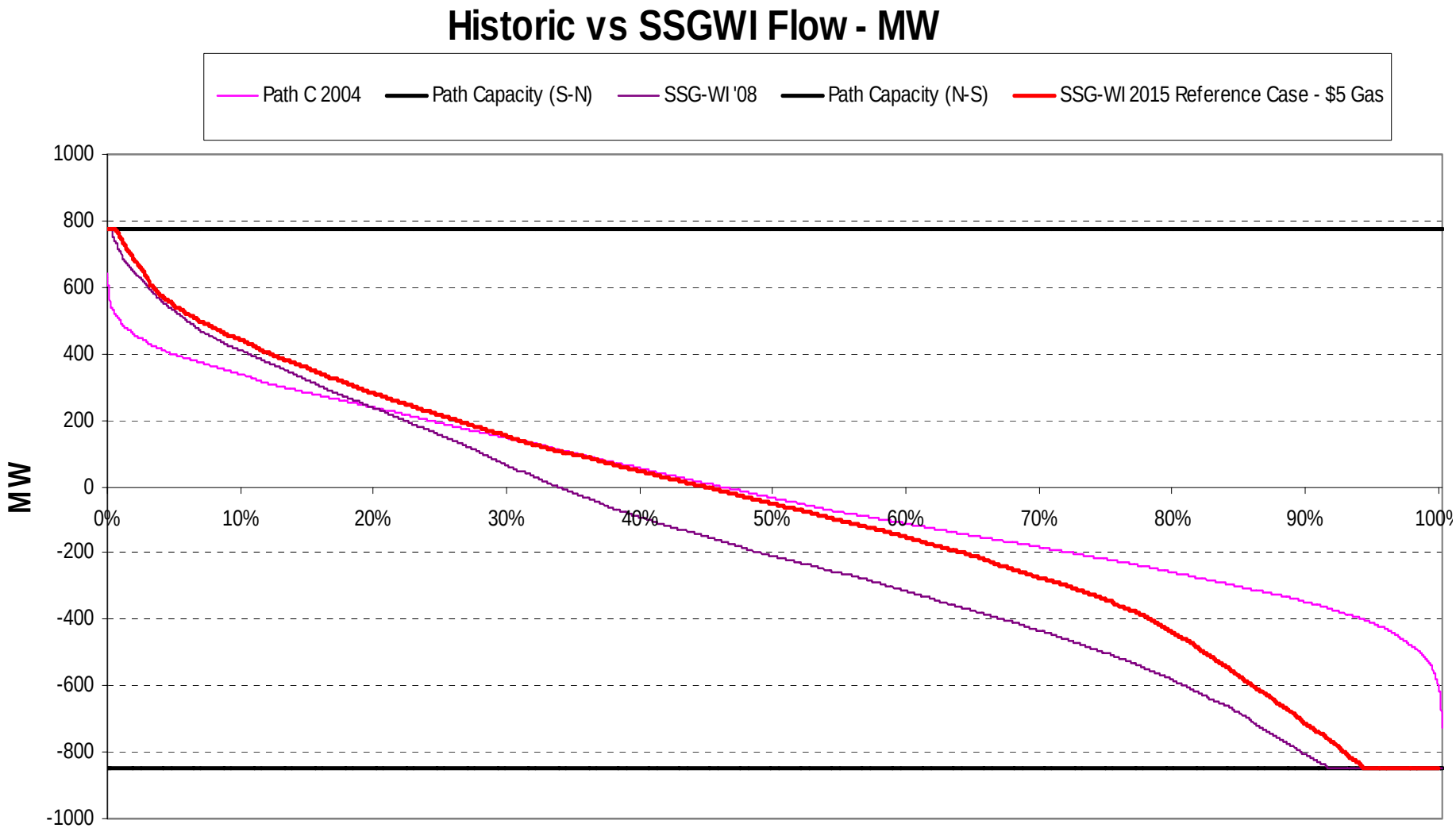
Bridger West

Historic vs SSGWI Flow - MW

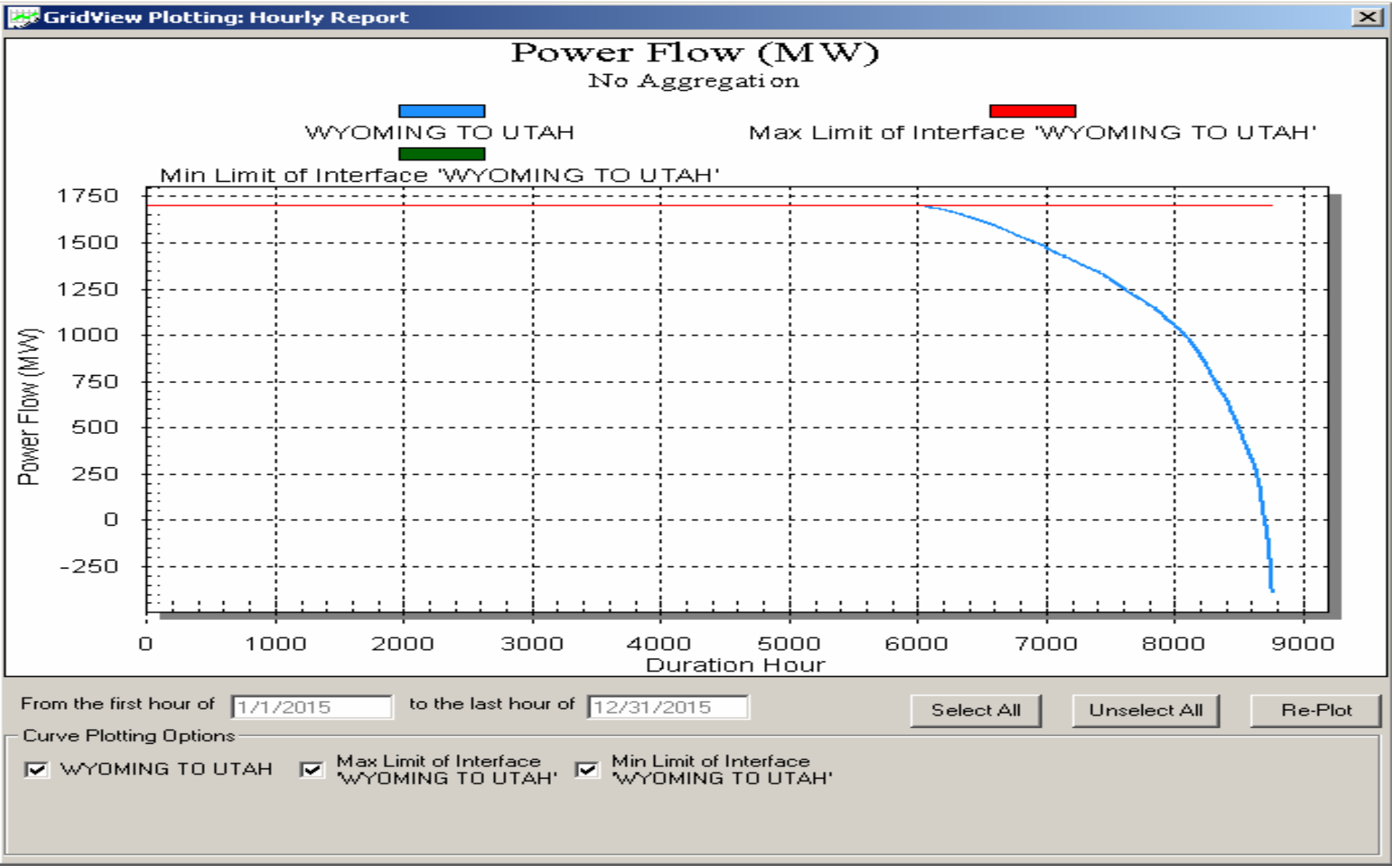


Path C

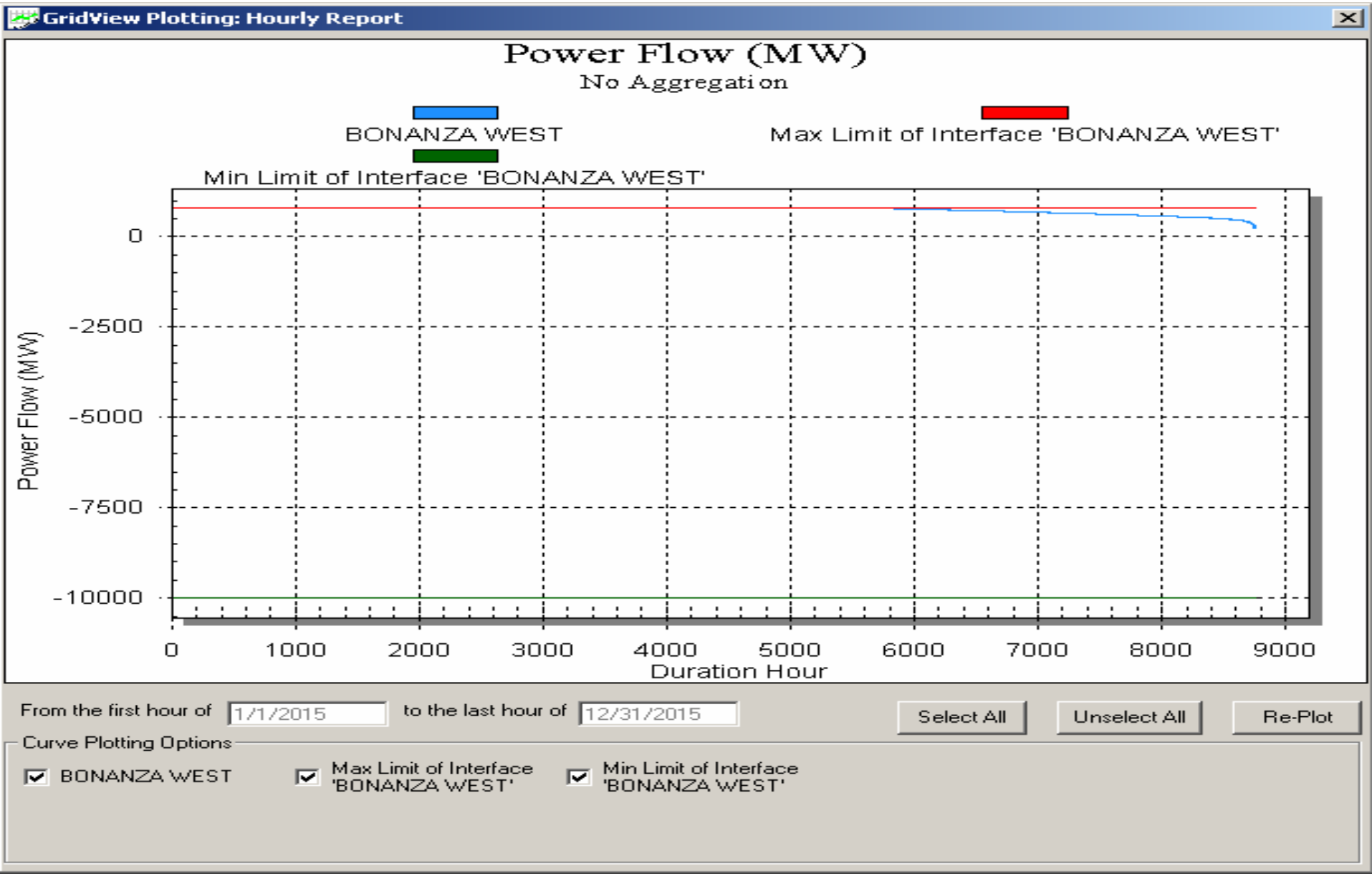
Northern Utah/southern Idaho



Wyoming to Utah

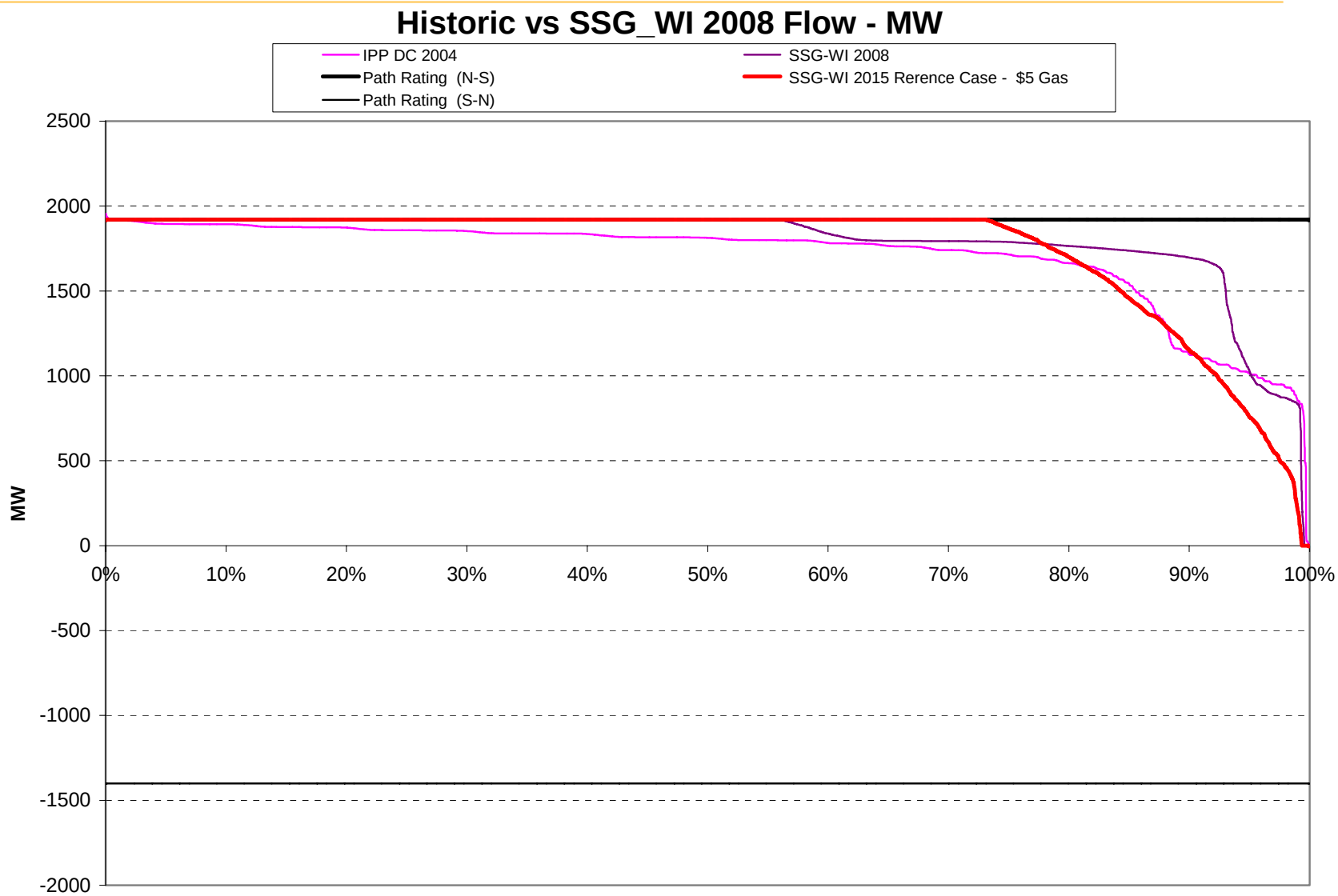


Bonanza West



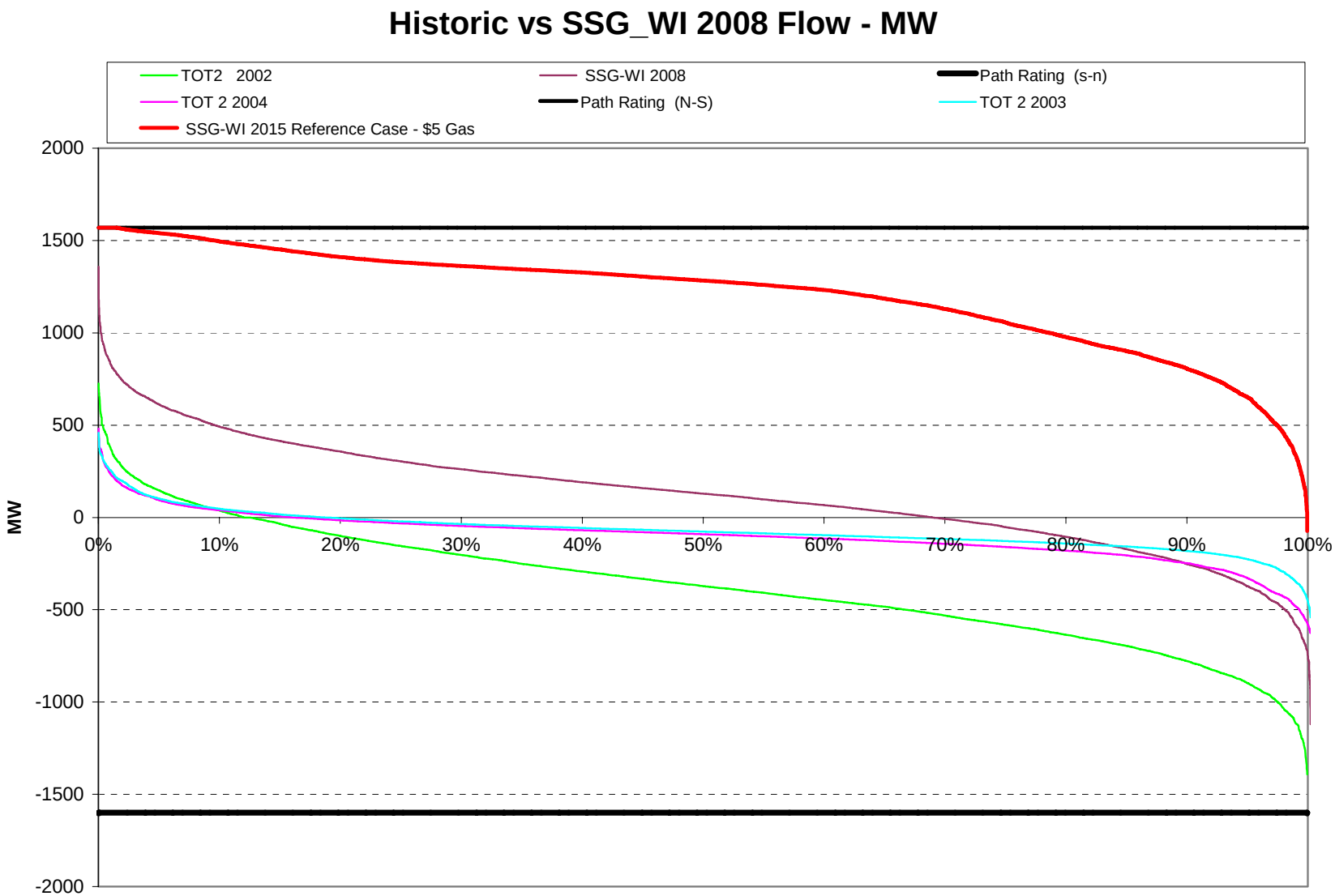
IPP DC

Intermountain to Adelanto station in southern California



TOT2 (A+B+C) Duration Curve

Southern CO, southern Utah to N. Arizona and southern Utah to South-East Nevada



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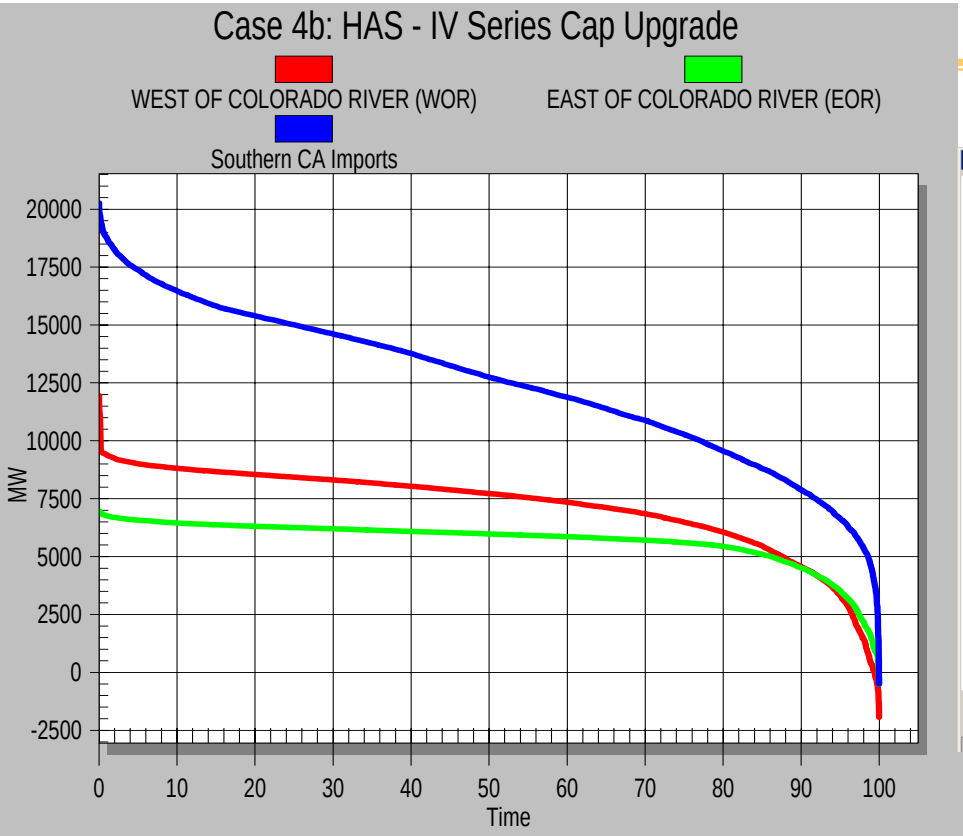
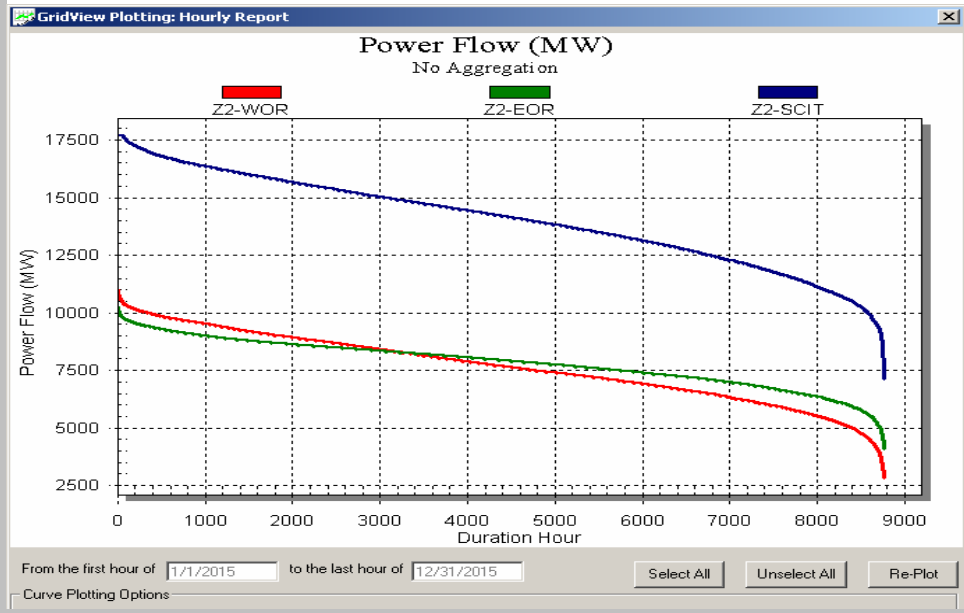
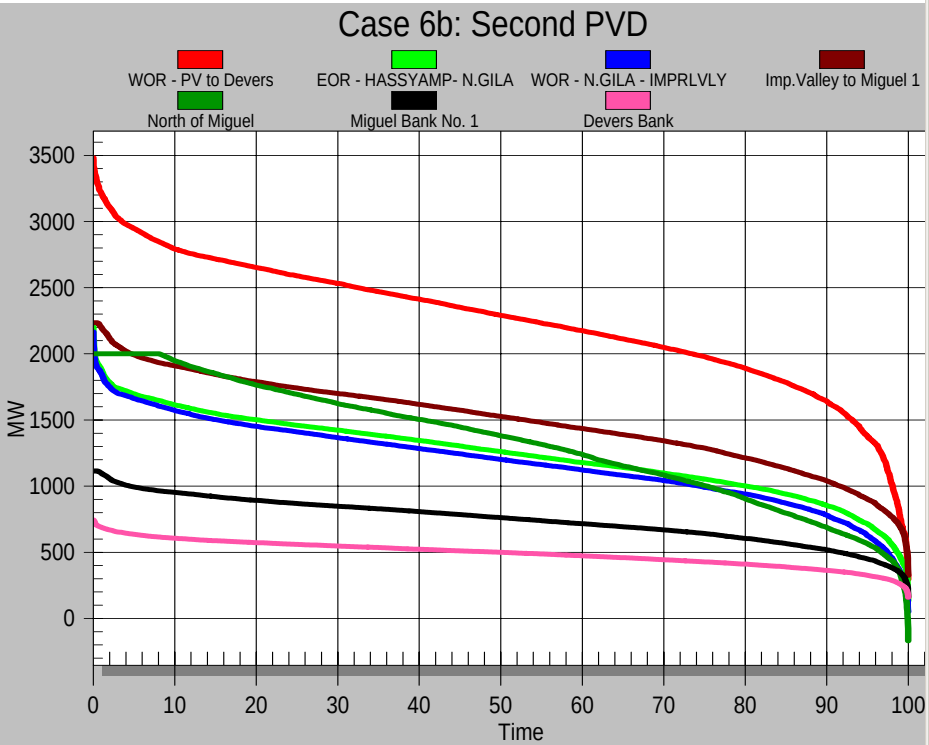
January 30, 2006



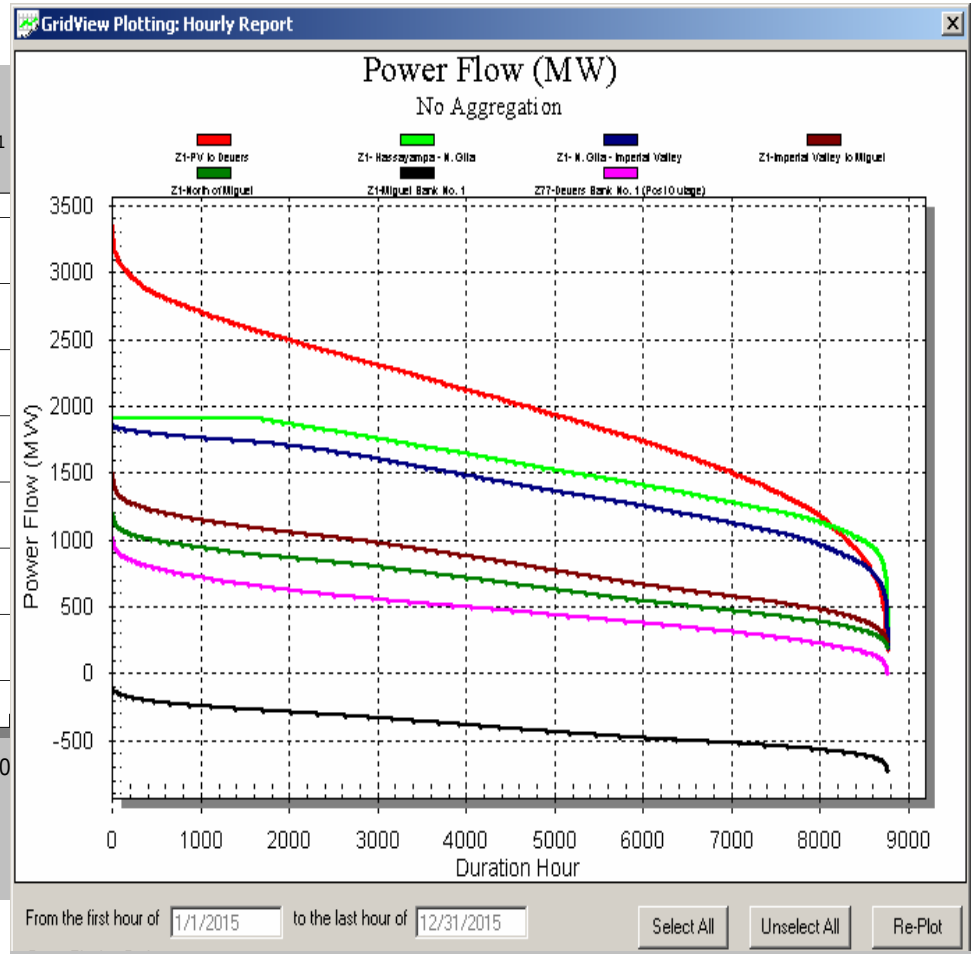
CAISO Study Results HAS – IV Series Cap Upgrade



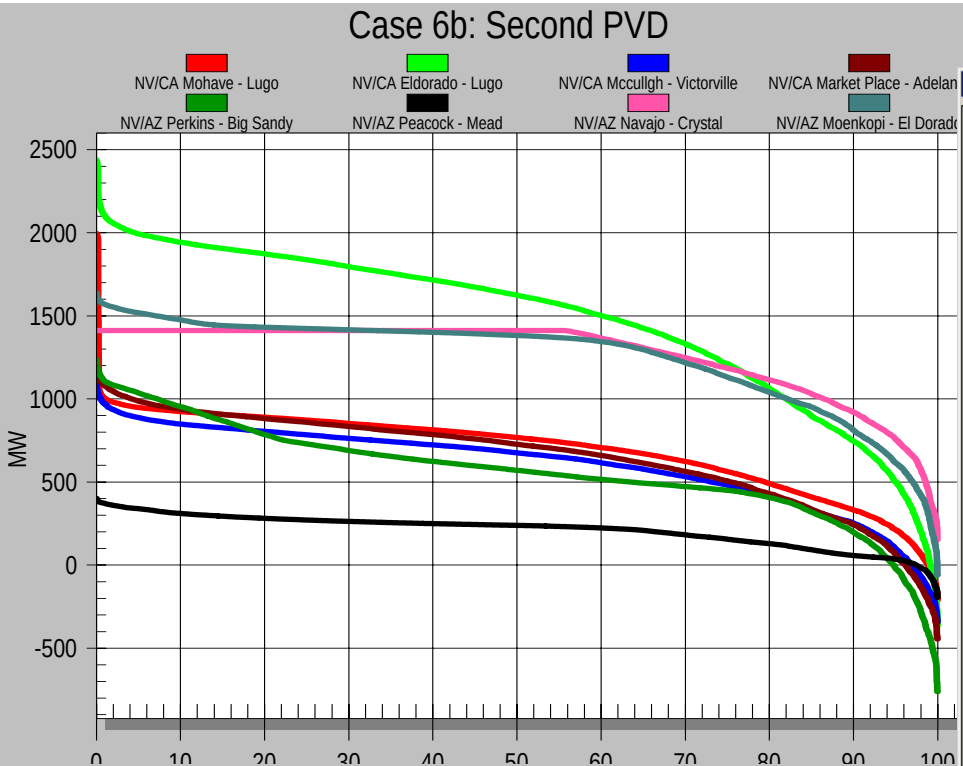
SSG-WI 2015 Reference Case



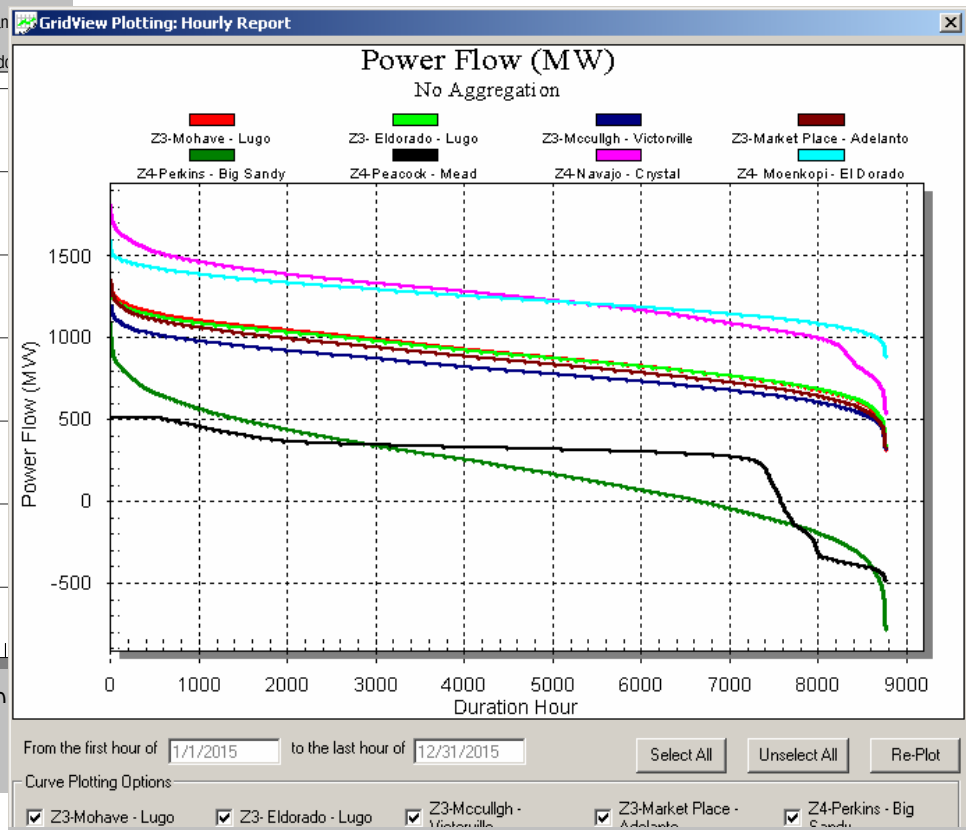
CAISO Study Results for PV to Devers #2
February, 2005



SSG-WI 2015
Reference Case



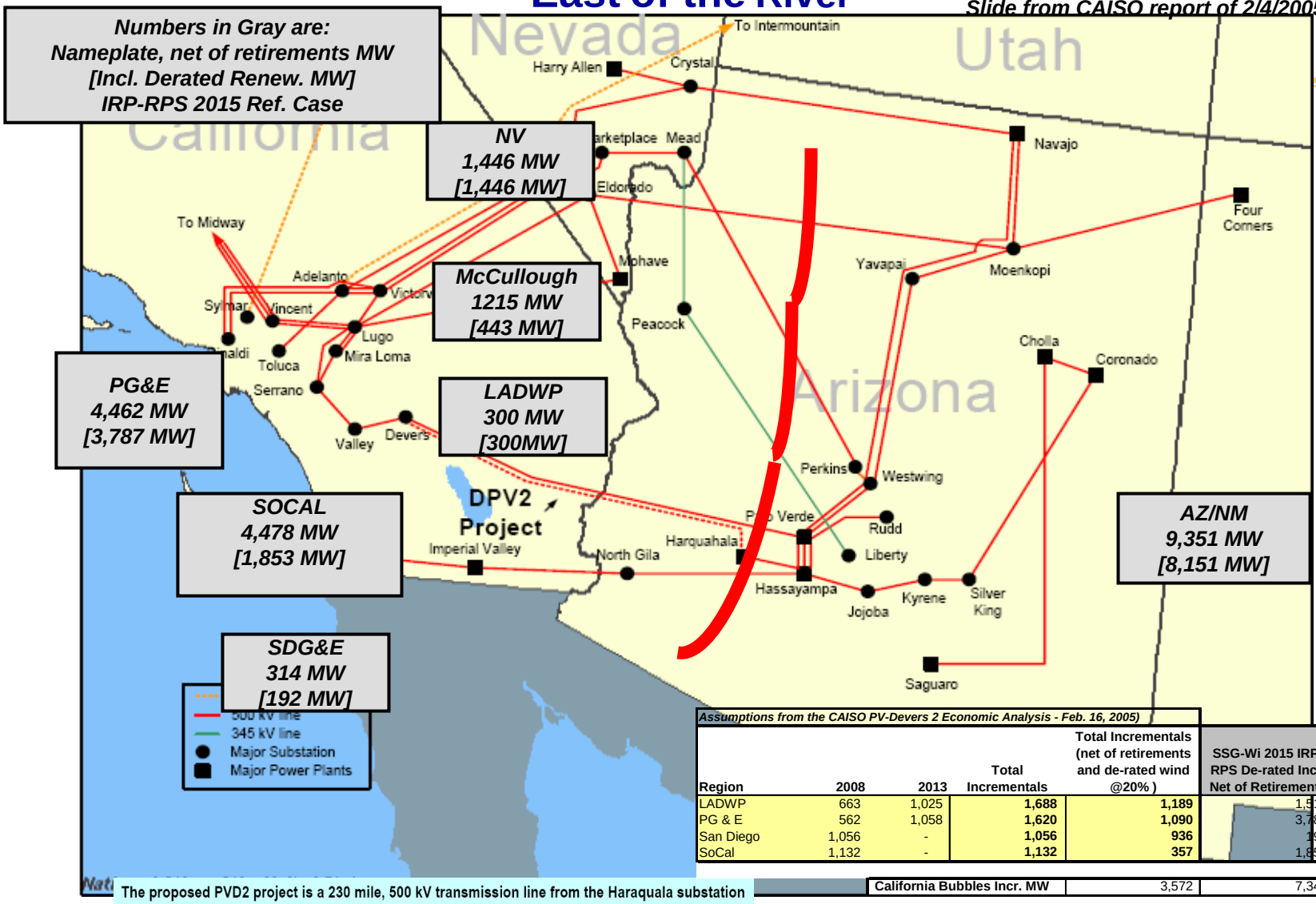
CAISO Study Results for PV to Devers #2
February, 2005



SSG-WI 2015
Reference Case

East of the River

Slide from CAISO report of 2/4/2005

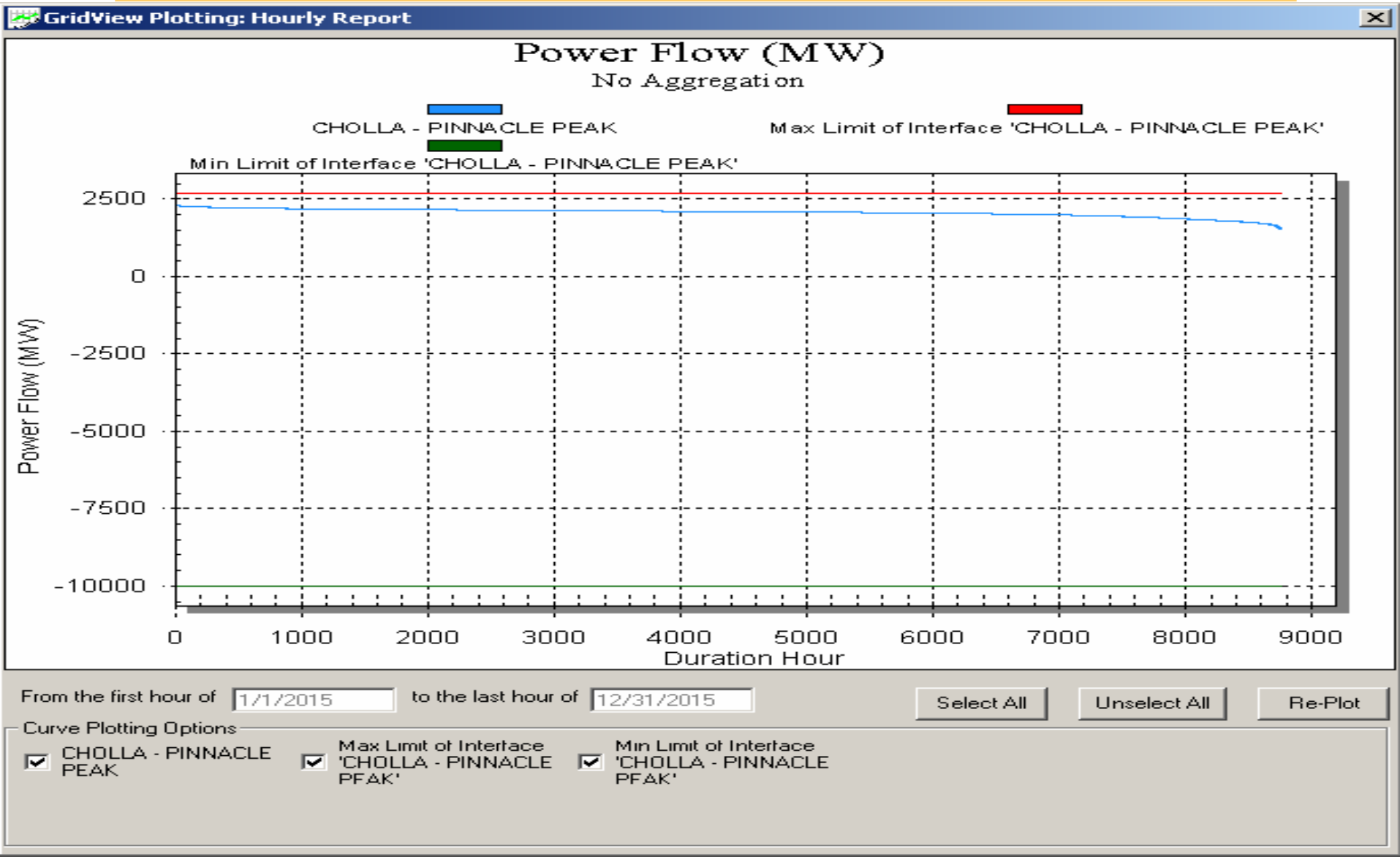


Assumptions from the CAISO PV-Devers 2 Economic Analysis - Feb. 16, 2005)

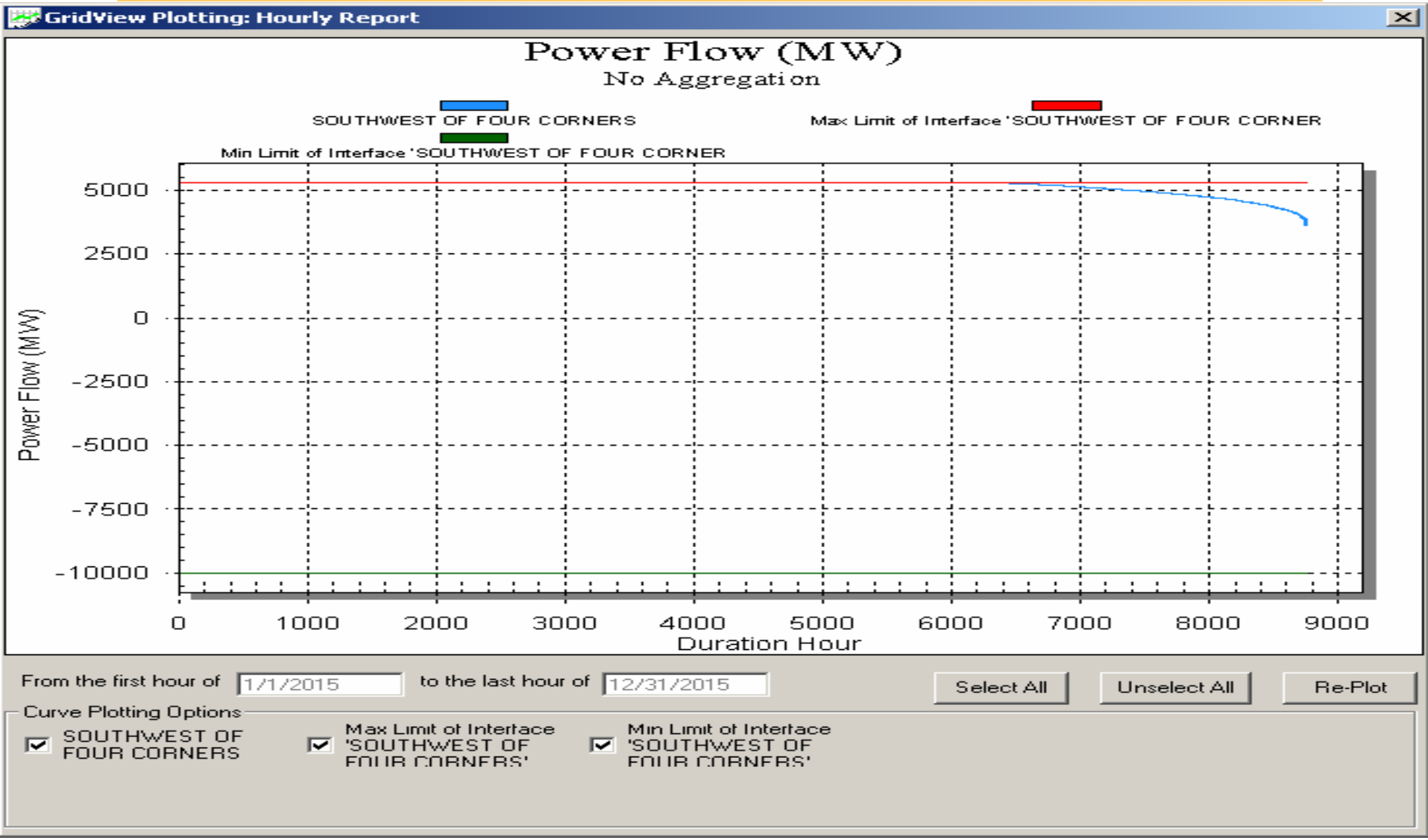
Region	2008	2013	Total Incrementals	Total Incrementals (net of retirements and de-rated wind @20%)	SSG-Wi 2015 IRP-RPS De-rated Incr, Net of Retirements
LADWP	663	1,025	**1,688**	**1,189**	1,515
PG & E	562	1,058	**1,620**	**1,090**	3,787
San Diego	1,056	-	**1,056**	**936**	192
SoCal	1,132	-	**1,132**	**357**	1,853
			California Bubbles Incr. MW	3,572	7,347

The proposed PVD2 project is a 230 mile, 500 kV transmission line from the Haraquala substation near Palo Verde to SCE's Devers substation near Palm Springs, California. PVD2 will parallel the existing PVD1 line and will use the existing PVD1 right-of-way.

Cholla – Pinnacle Peak

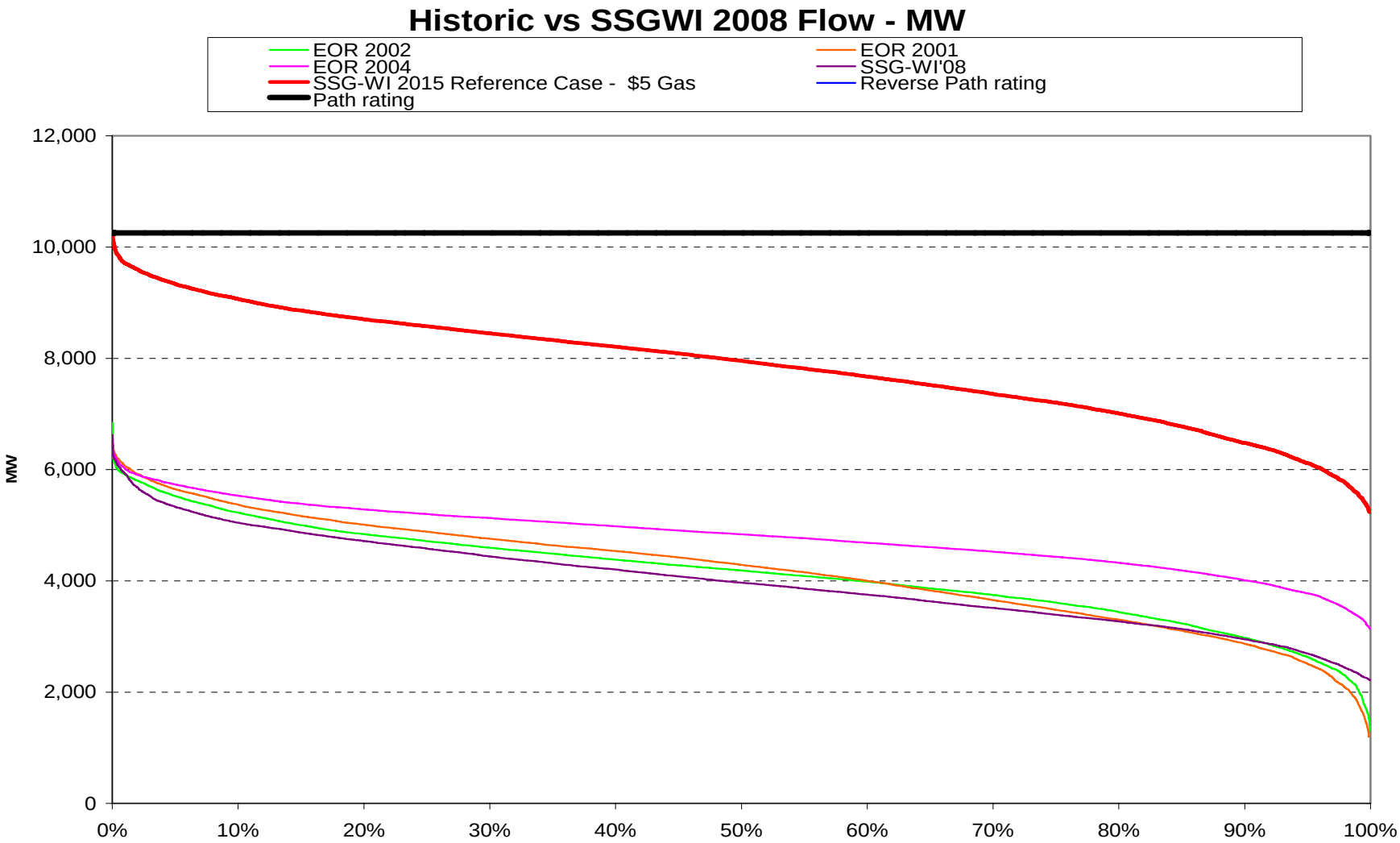


Southwest of Four Corners



East of the River Duration Curve

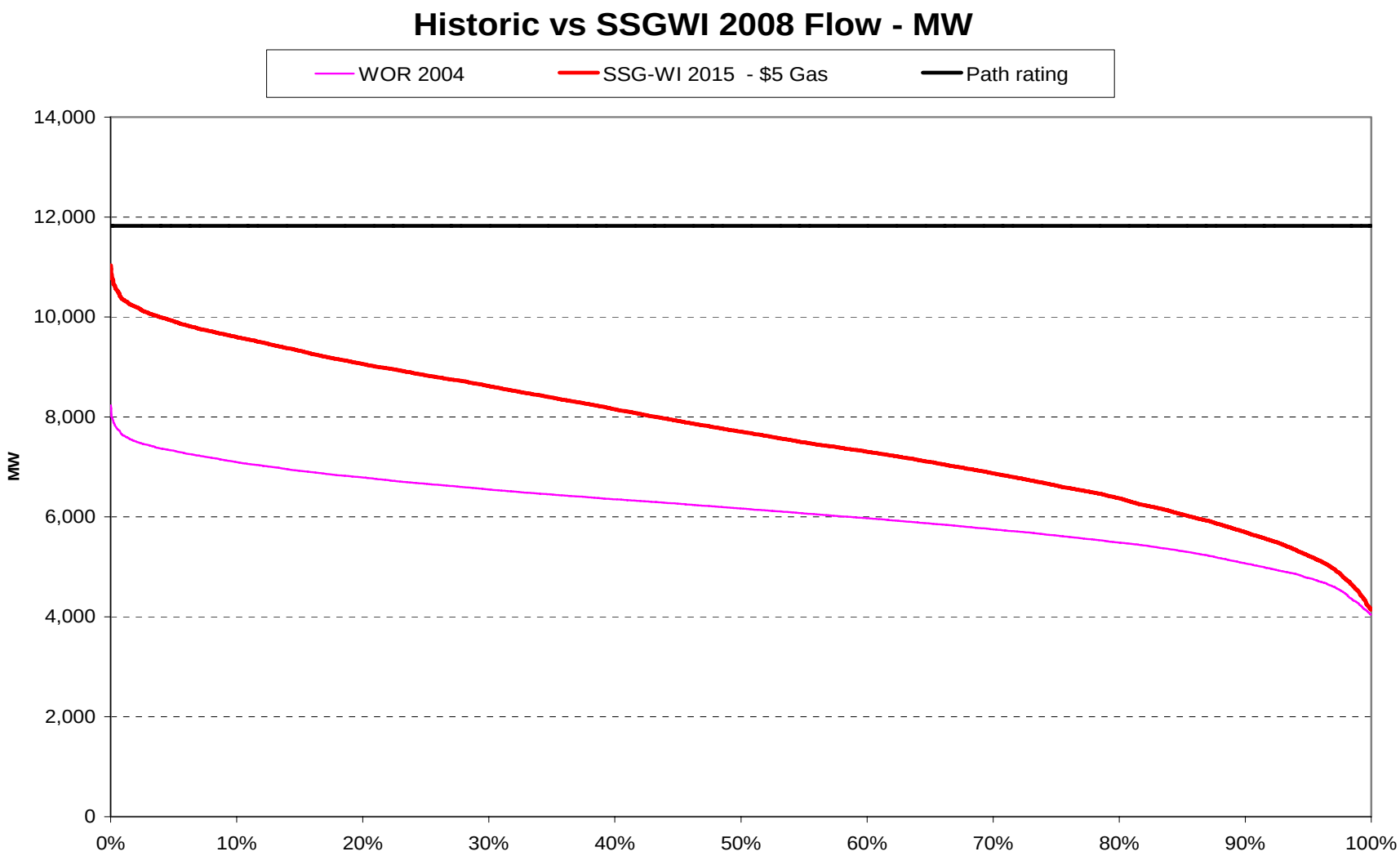
Western Arizona



2015 IRP-RPS Reference Case

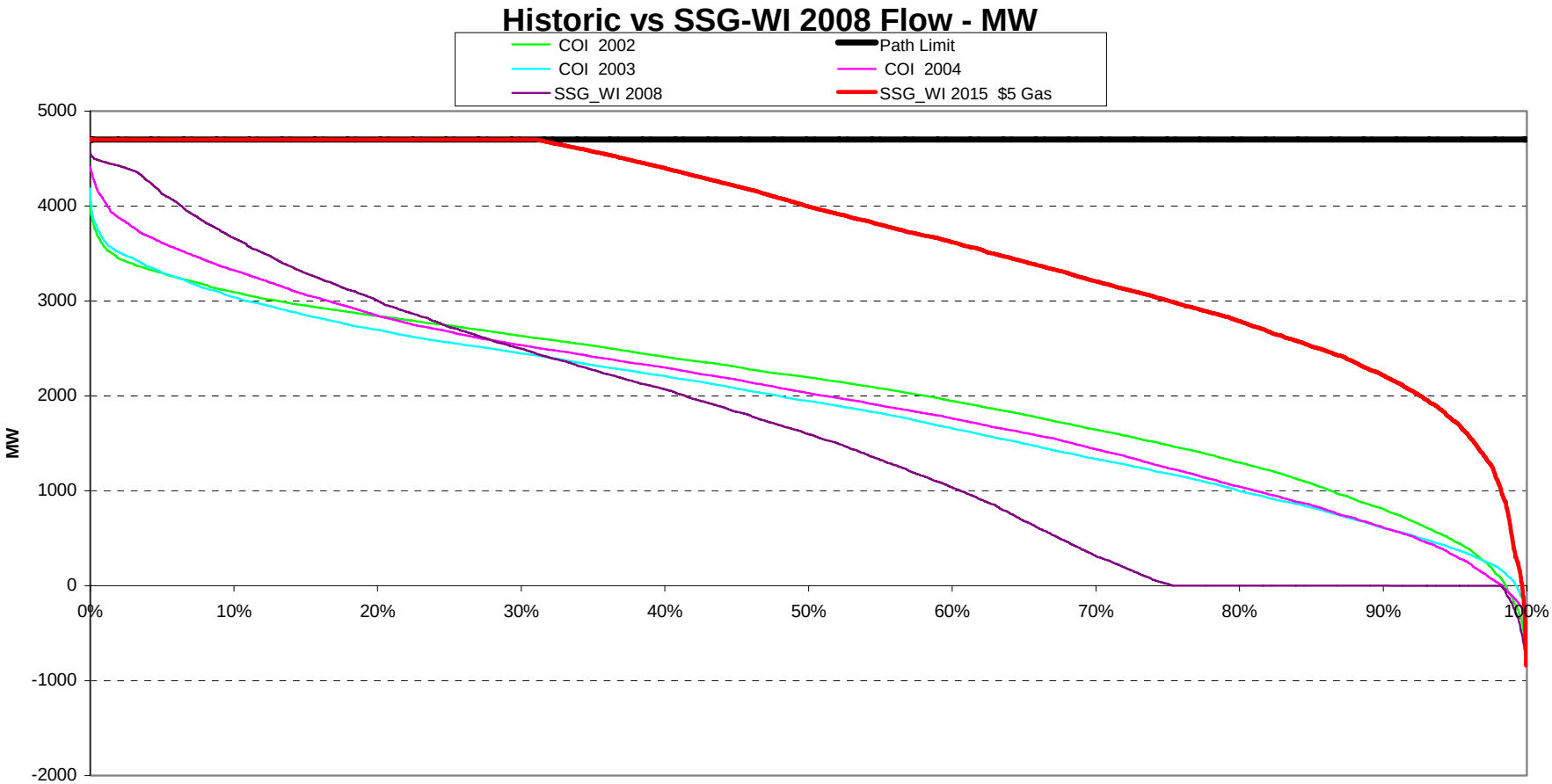
January 30, 2006

West of the River Duration Curve



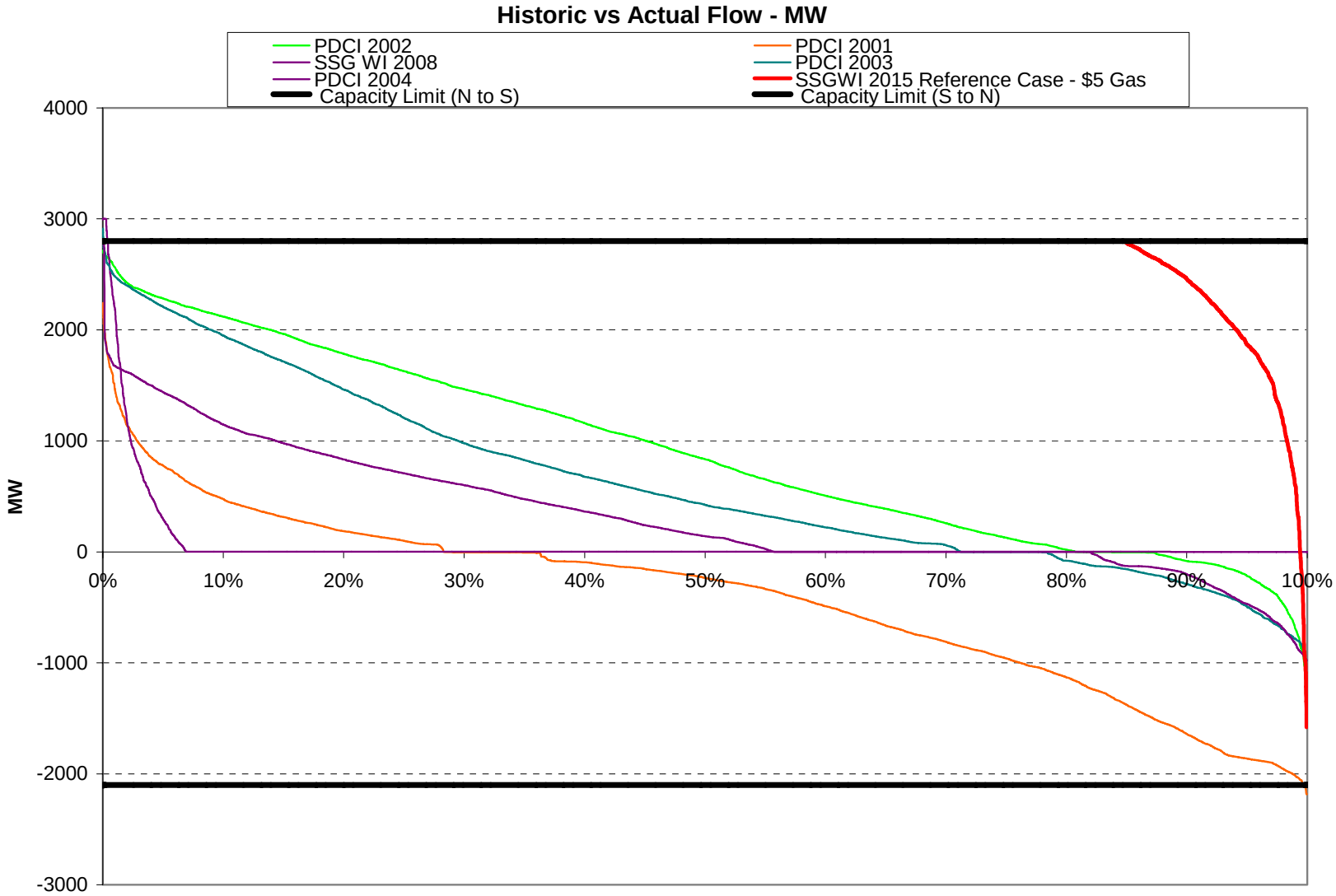
COI

Between Oregon and northern California



PDCI

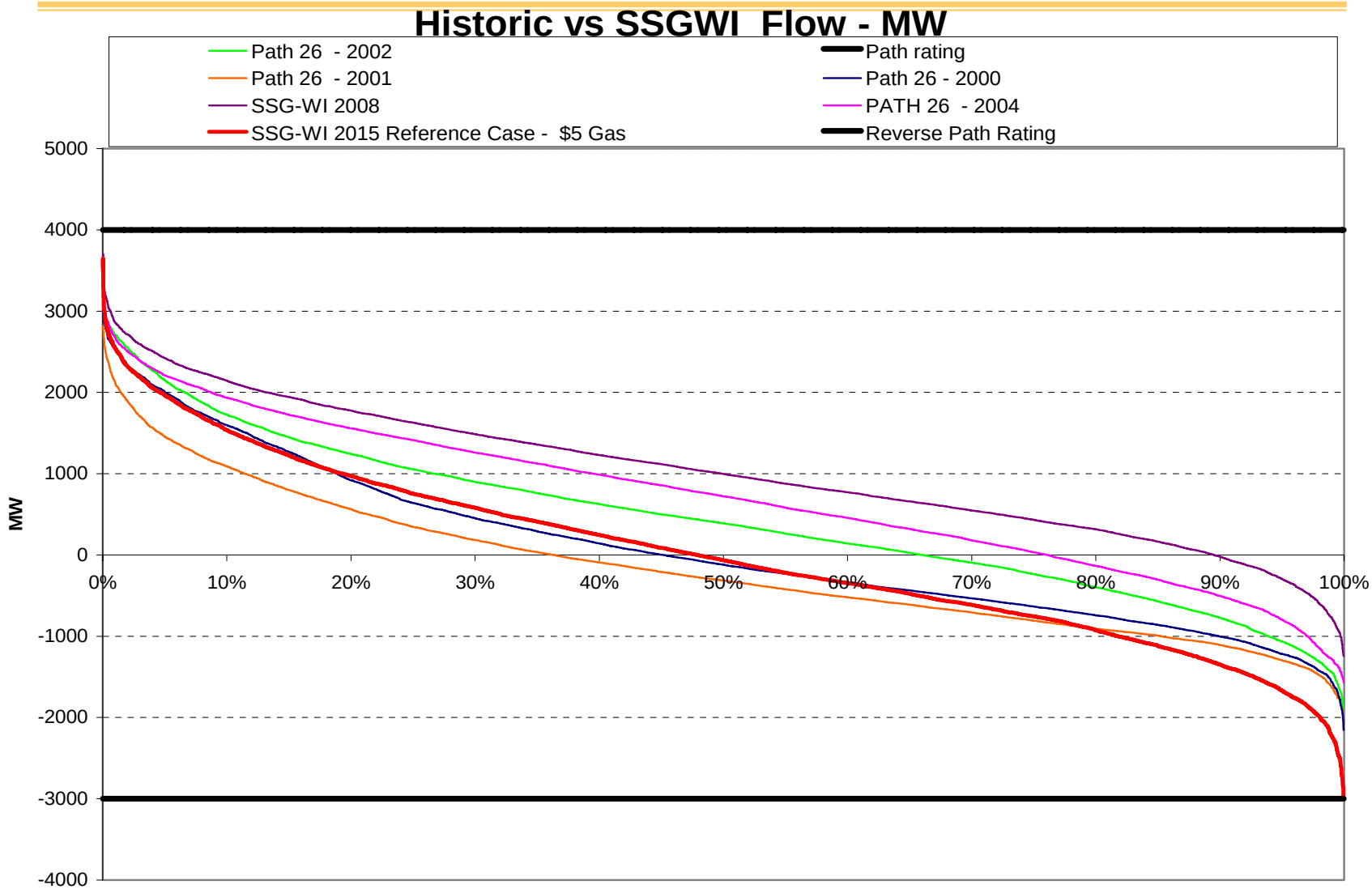
This path (between northern Oregon and Los Angeles) shows high utilization



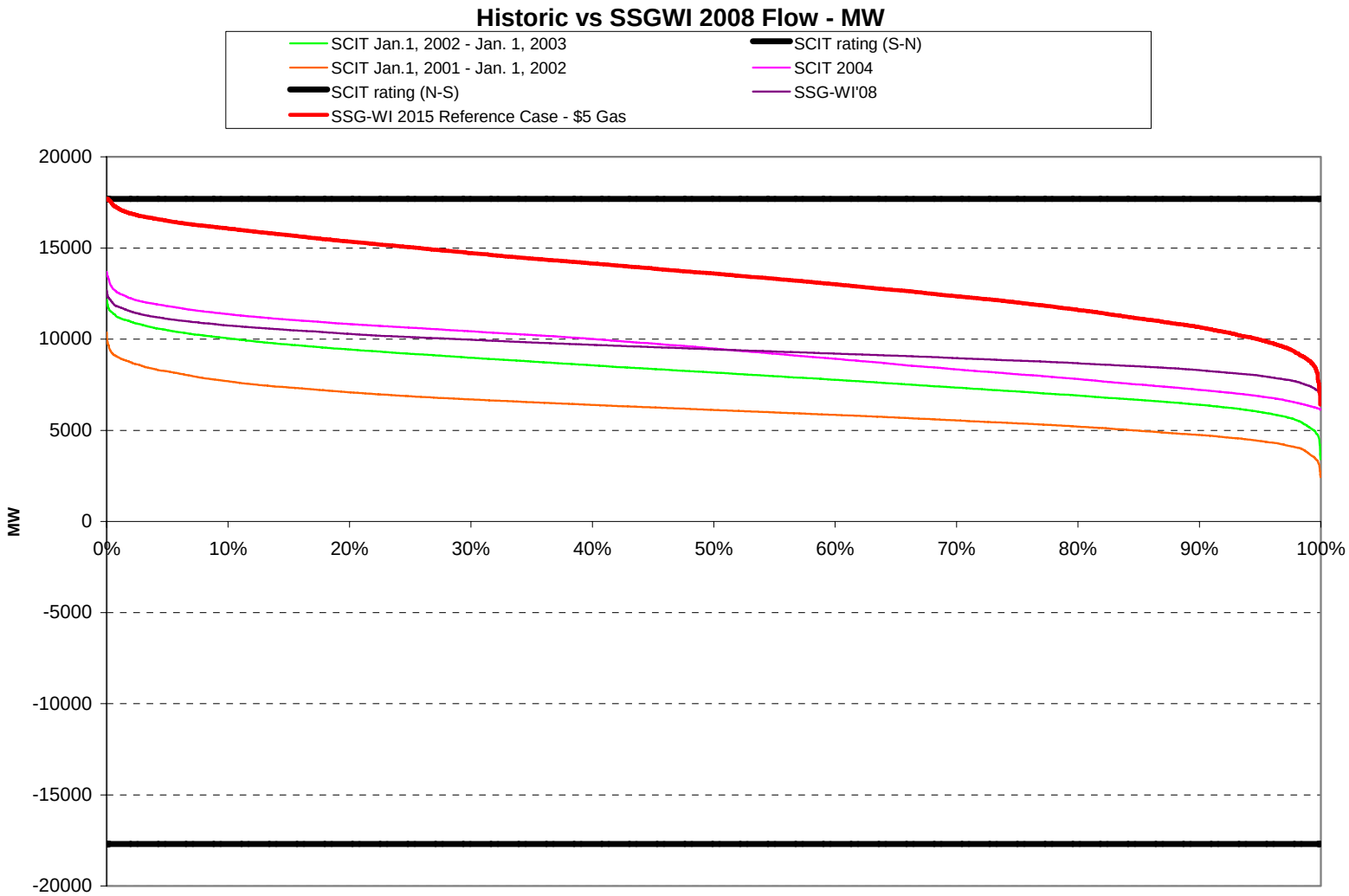
2015 IRP-RPS Reference Case

January 30, 2006

Path 26 Duration Curve



SCIT Duration Curve



Post SSG-Wi: Refinements to the Database (1)

- Economics table
  - Essential for comparing full cost of scenarios
  - Tune-up transmission capex
    - Capital costs for transmission added since December 22, 05 presentation
    - Final review of generic assumptions
    - Capital charge sensitivities
  - Tune-up resource capex
    - Alberta resources
    - Energy efficiency capex behind the load forecasts
    - Revisit wind “wear and tear” on thermals
    - Capital charge sensitivities
- Additional resource case(s)
  - Sensitivities around the reference case
  - Too many resources – 29% planning margin for region (on discounted capacity basis)
  - Level and location of renewables and energy efficiency investment
  - Load forecast sensitivities

Post SSG-Wi: Refinements to Database (2)

- Disaggregate load forecasts
  - Transmission losses
  - DSM and energy efficiency
  - Assignment of load to topology bubbles
  - Hourly shape sensitivities
- Hydro generation
  - Low and high sensitivities (in combo with gas price cases)
  - BC hydro generation modeling
  - Test dynamic hydro algorithm
- Cogeneration data
  - Verification of net to grid MWs
- Review heat rate curves assigned to technology types and assignment of technology and fuel types to thermal resources
- Incorporate CDEAC study resource characteristics, e.g. thermal non-coal/gas fuel prices
- Review certain bus assignments/transmission to integrate new resources
- Data for wheeling charges