

Tracing Formulae

HAI Model 5.3-CA

California PUC

December 5, 2002

Three types of “hard coded” numbers in HM Output workbook

1. User-adjustable inputs
 - **Carry forward directly from user interface**
2. ARMIS inputs
 - **Taken from ARMIS database file**
 - **Traceable to ARMIS reports filed by SBCP with FCC**
3. Investment inputs
 - **Focus of this presentation**
 - **We'll show how investment numbers flow from various components of the model to final outputs**

NID Annual Cost (Unit Cost Worksheet)

NID Annual Cost (L8) is the sum of annual cost for each density zone (C8-K8)

Excel File Edit View Insert Format Tools Data Window Help

CA Pacific Bell, Delmar-SBRES.MXS

California Pacific Bell

Cost of Network Elements

Line	Element	Unit	Annual Cost	Unit Cost	Annual Cost	Unit Cost	Annual Cost	Unit Cost	Annual Cost	Unit Cost	Annual Cost	Unit Cost	Annual Cost	Unit Cost	Annual Cost	Unit Cost	Annual Cost	Unit Cost
1	Loop Identification (LIC)	Annual Cost	25,025,247	17.84	17,228,803	12.55	31,054,887	21.95	8,728,878	6.58	80,264,237	60.42	61,427,458	46.44	18,400,289	13.92	314,887,054	239.53
2	Loop Identification (LIC)	Unit Cost	17,84	1	12.55	1	21.95	1	6.58	1	60.42	1	46.44	1	13.92	1	239.53	1
3	Loop Identification (LIC)	Annual Cost	17,341	10.88	7,895,573	5.60	9,290,329	6.68	2,355,822	1.72	20,877,645	15.41	87,381,639	64.64	93,343,527	69.67	227,131,644	172.91
4	Loop Identification (LIC)	Unit Cost	10.88	1	5.60	1	6.68	1	1.72	1	15.41	1	64.64	1	69.67	1	172.91	1
5	Loop Identification (LIC)	Annual Cost	26,114,283	17.87	13,071,578	9.52	38,307,237	28.33	12,874,010	9.52	81,837,192	61.58	150,578,880	112.94	117,328,869	88.57	822,304,888	621.21
6	Loop Identification (LIC)	Unit Cost	17.87	1	9.52	1	28.33	1	9.52	1	61.58	1	112.94	1	88.57	1	621.21	1
7	Loop Identification (LIC)	Annual Cost	4,877,852	3.59	7,882,288	5.75	20,832,288	15.38	9,361,591	6.86	41,954,835	31.31	88,857,881	66.14	15,289,385	11.37	288,718,398	220.62
8	Loop Identification (LIC)	Unit Cost	3.59	1	5.75	1	15.38	1	6.86	1	31.31	1	66.14	1	11.37	1	220.62	1
9	Loop Identification (LIC)	Annual Cost	2,520	0.85	81,334	0.59	535,802	0.39	188,772	0.14	1,776,623	1.32	3,358,829	2.52	7,192,748	5.37	17,820,708	13.43
10	Loop Identification (LIC)	Unit Cost	0.85	1	0.59	1	0.39	1	0.14	1	1.32	1	2.52	1	5.37	1	13.43	1
11	Loop Identification (LIC)	Annual Cost	8,898,032	6.58	7,814,873	5.68	21,894,288	16.24	7,379,273	5.47	50,724,898	38.14	94,888,825	71.24	29,481,814	22.08	288,887,184	220.62
12	Loop Identification (LIC)	Unit Cost	6.58	1	5.68	1	16.24	1	5.47	1	38.14	1	71.24	1	22.08	1	220.62	1
13	Loop Identification (LIC)	Annual Cost	17,785,870	13.59	18,150,247	13.59	2,418,818	1.82	702,888	0.53	4,811,487	3.62	6,871,958	5.15	1,435,848	1.09	64,877,888	49.33
14	Loop Identification (LIC)	Unit Cost	13.59	1	13.59	1	1.82	1	0.53	1	3.62	1	5.15	1	1.09	1	49.33	1

NID Direct Expense (Exp by Service worksheet)

NID Direct Expense (C8) is sum of Annual Capital Cost (C6) and Network Expenses (C7)

	100-250	200-400	400-600	600-800	800-1000	1000-1500	1500-2000	2000-3000	3000-4000	4000-5000	5000-6000	6000-7000	7000-8000	8000-9000	9000-10000	Total
Network-Related Expenses																
Annual Capital Cost	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	1,538,773	15,387,730
Network Expenses	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	961,262	9,612,620
Direct Expense	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	2,500,035	25,000,350
Investment	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	13,914,187	139,141,870
Support, Overhead and direct per line	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	51,899	518,990
Support & Overhead per direct exp.	84,911	84,911	84,911	84,911	84,911	84,911	84,911	84,911	84,911	84,911	84,911	84,911	84,911	84,911	849,110	
Total	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	3,226,632	32,266,320
with certain re-credits	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	3,309,275	33,092,750
Disbursements (NID)																
Annual Capital Cost	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	14,514,051	145,140,510
Network Expenses	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	3,163,710	31,637,100
Direct Expense	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	17,677,761	176,777,610
Investment	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	1,218,534,510
Support, Overhead and direct per line	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	1,321,820
Support & Overhead per direct exp.	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	23,632,300
Total	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	257,961,530
with certain re-credits	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	290,292,470
Disbursement (non-NID)																
Annual Capital Cost	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	42,250	422,500
Network Expenses	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	9,488	94,880
Direct Expense	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	51,738	517,380
Investment	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	451,551,099	4,515,510,990
Support, Overhead and direct per line	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	23,495	234,950
Support & Overhead per direct exp.	76,531	76,531	76,531	76,531	76,531	76,531	76,531	76,531	76,531	76,531	76,531	76,531	76,531	76,531	765,310	
Total	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	77,241	772,410
with certain re-credits																
Disbursement (all)																
Annual Capital Cost	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	14,556,301	145,563,010
Network Expenses	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	3,173,198	31,731,980
Direct Expense	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	17,729,499	177,294,990
Investment	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	121,853,451	1,218,534,510
Support, Overhead and direct per line	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	132,182	1,321,820
Support & Overhead per direct exp.	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	2,363,230	23,632,300
Total	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	25,796,153	257,961,530
with certain re-credits	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	29,029,247	290,292,470

NID Levelized Cost of Capital (Distribution worksheet)

NID Cost of Capital (B155) is NID Investment (B154) multiplied by the annual capital cost factor (INDEX(KACF,13)) for this category of equipment

Excel File Edit View Insert Format Tools Data Window Help

File Edit View Insert Format Tools Data Window Help

155 -B155=INDEX(KACF,13)

CA_Pacific Bell_Default5\FBS.xls

155	TOTAL	\$ 3,875,406	\$ 8,400,883	\$ 1,681,403	\$ 6,007,456	\$ 1,428,241	\$ 13,045,631	\$ 14,352,765
156	Summary							
157	Cost of Capital	\$ 14,567,000	\$ 31,193,233	\$ 6,137,603	\$ 20,113,626	\$ 4,248,023	\$ 12,750,184	\$ 52,074,473
158	Network Expense	\$ 3,178,406	\$ 2,482,663	\$ 3,981,403	\$ 2,007,456	\$ 1,908,241	\$ 13,945,631	\$ 14,352,765
159	TOTAL	\$ 17,722,113	\$ 39,889,328	\$ 10,119,006	\$ 21,121,402	\$ 6,141,415	\$ 55,745,815	\$ 87,027,238
160	NID Cost							
161	NID Investment	\$ 2,000,000	\$ 19,044,597	\$ 5,060,983	\$ 24,874,889	\$ 7,280,727	\$ 58,218,608	\$ 80,248,728
162	Levelized Cost of Capital	\$ 1,567,000	\$ 1,633,729	\$ 685,382	\$ 2,157,683	\$ 859,632	\$ 4,088,333	\$ 4,482,462
163	Network Expense	\$ 1,611,406	\$ 294,242	\$ 241,422	\$ 811,799	\$ 313,460	\$ 7,893,987	\$ 3,254,221
164	TOTAL	\$ 600,140	\$ 2,120,008	\$ 928,974	\$ 3,887,472	\$ 1,665,332	\$ 9,271,840	\$ 12,406,883

NID Investment (Distribution worksheet)

NID Investment (B154) is the sum of cells AK3 and AK12 on the "Investment Input" worksheet

Excel File Edit View Insert Format Tools Data Window Help

Investment Input AK3 Investment Input AK12

CA Pacific Bell Default\$B\$5.xls

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
143	TOTAL	\$	3,172,005	\$	8,485,883	\$	1,551,403	\$	8,697,286	\$	1,528,341	\$	13,846,031	\$	14,862,768
144	Summary														
145	Cost of Capital	\$	14,587,405	\$	31,463,233	\$	6,877,905	\$	28,413,578	\$	6,278,073	\$	42,759,984	\$	32,872,473
146	Network Expense	\$	2,975,006	\$	6,666,583	\$	1,851,403	\$	8,007,289	\$	1,820,341	\$	13,045,004	\$	14,952,185
147	TOTAL	\$	17,722,813	\$	38,159,828	\$	8,788,008	\$	28,121,407	\$	8,044,413	\$	48,778,318	\$	57,427,238
148															
149	NID Cost														
150	NID Investment	\$	2,350,799	\$	11,844,587	\$	3,850,983	\$	28,174,879	\$	7,246,737	\$	58,318,306	\$	50,286,728
151	Lowest Cost of Capital		281,476		1,535,373		881,302		2,427,863		841,532		8,494,333		9,482,262
152	Network Expense		118,873		584,282		241,872		951,788		313,860		2,288,987		2,358,221
153	TOTAL	\$	408,248	\$	2,120,235	\$	4,954,157	\$	3,258,452	\$	1,189,532	\$	6,371,948	\$	12,088,333
154															
155															
156															
157															
158															
159															
160															
161															
162															
163															
164															
165															
166															
167															
168															
169															
170															
171															
172															
173															
174															
175															
176															
177															
178															

NID Investment (R53_distribution.xls workbook, "Outputs" worksheet)

These in turn are a "rollup" (performed by a query in the hm.db Access database) from the cluster-level outputs of the Distribution Module...

	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
	RT investment	RT upside	Investment -ADBC	Investment	SAI	Investment	Investment	dep	breakpoint	breakpoint	breakpoint	breakpoint
1	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												

NID Investment rollup (hm.db Access database query)

Database query called by master.xls sums investment by density zone

```
Microsoft Access - [total_network_inv_by_density_non_slc : Union Query]
File Edit View Insert Query Table Window Help
SELECT 0 AS density_zone, "non-DLC" AS feeder_type, sum((total_lines)) AS total_lines, sum((business_lines)) AS business_lines, sum((SA_lines)) AS sa_lines, sum((public_lines)) AS public_lines, sum((single-line business_lines)) AS SLB_lines, sum((households)) AS h
fdr_cpr_cable_ug, sum((cpr_fdr_cbl_buried)) AS fdr_cpr_cable_buried, sum((cpr_fdr_cbl_aerial)) AS fdr_cpr_cable_aerial, sum((fiber_fc
fdr_fiber_cable_ug, sum((fiber_fdr_cbl_buried)) AS fdr_fiber_cable_buried, sum((fiber_fdr_cbl_aerial)) AS fdr_fiber_cable_aerial, sum((
sum((Expr2)) AS fdr_manholes_adj, sum((Expr3)) AS fdr_cpr_plcmt_ug_adj, sum((Expr4)) AS fdr_fiber_plcmt_ug_adj, sum((Expr5))
fdr_cpr_plcmt_buried_adj, sum((Expr6)) AS fdr_fiber_plcmt_buried_adj, sum((Expr7)) AS fdr_pole_inv, sum((dist_cable_undergroun
sum((dist_cable_buried)) as dist_cable_buried, sum((dist_cable_aerial)) as dist_cable_aerial, sum((distribution_conduit)) as dist_conduit
placement)) as dist_conduit_plcmt, sum((dist_buried_plant)) as dist_buried_plant, sum((dist_poles)) as dist_poles, avg((calc_cpr_fdr_fill
avg((calc_dist_fill)) AS calc_dist_fill, avg((calc_mainframe_fill)) AS calc_mainframe_fill, sum((DLC_inv_w/site)) AS DLC_inv_w/site, si
sum((terminal_inv)) AS terminal_inv, sum((drop_inv)) AS drop_inv, sum((DLC_lines)) AS DLC_lines, sum((feeder_distance)) AS feeder_dist
distance)) AS total_dist_distance, sum((DLC_lines)) AS DLC_lines, sum((Expr8)) AS end_office_switching, sum((Expr9)) AS MDF_prot
end_office_wire_center, sum((Expr1)) AS land, sum((Expr12)) AS local_tandem_switching, sum((Expr13)) AS local_tandem_wire_ct
OS_tandem_switching, sum((Expr15)) AS OS_tandem_wire_center, sum((Expr16)) AS OS_trunks, sum((Expr17)) AS operator_positi
common_transport_ug, sum((Expr19)) AS common_transport_buried, sum((Expr20)) AS common_transport_aerial, sum((Expr21)) AS
sum((Expr22)) AS common_transport_conduit, sum((Expr23)) AS common_transport_manholes, sum((Expr24)) AS common_transmis
sum((Expr25)) AS direct_transport_ug, sum((Expr26)) AS direct_transport_buried, sum((Expr27)) AS direct_transport_aerial, sum((
direct_transport_poles, sum((Expr29)) AS direct_transport_conduit, sum((Expr30)) AS direct_transport_manholes, sum((Expr31)) AS
direct_transmission_terminal_inv, sum((Expr32)) AS dead_transport_in, sum((Expr33)) AS dead_transport_buried, sum((Expr34)) AS
```

NID Investment (R53_distribution.xls, "calculations" worksheet)

...where the investment calculations take place

Microsoft Excel - R53_distribution.xls - "calculations" - Help

Formula Bar: $=IF(CALCULATION$B102=0,10,CON*INPUTS$C330+((cluster input data Y2+('cluster input data 1 AX2+cluster input data Y2)*IF('cluster input data Y2+cluster input data Y2=0,0.6667, 'cluster input data Y2/('cluster input data Y2+cluster input data Y2)))^*input$C332+(1-(R2)*BX2-(input$C335+input$C336)^*cluster input data YAA2,MID_inbor*lines_adj)$

	DU	DV	DW	DX	DY	DZ
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						