Contemporary improvements in Piping BOQ

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In EPC project scenario, Piping BOQ poses to be a critical area, where cost, time and risk factors are all interrelated. Therefore, it requires periodic assessments, verifications and validation exercises in tandem with the progress of engineering, procurement and construction phases. At the same time, contemporary utility, usefulness, structure, look and feel of Piping BOQ have steadily gained importance to derive more actionable insights, to enable faster downstream decision making process and to ease the procurement process. Piping Material Specification (PMS) and Piping BOQ also play a significant role to minimize material inventory at site, during erection and construction phases of large projects. In view of all these expectations, Piping BOQ are nowadays prepared, maintained and reported with following sub-divisions / categories, if not more exhaustive. For system wise Piping BOQ also, such sub-divisions / categories are applicable.

a) Piping Size (inch NPS) wise Piping Bulks' MTO, comprising pipes, fittings, flanges, reinforced pads, o-let fittings etc.; Plugs, Caps, Unions, other branch fittings except o-let fittings to be reported under "Fittings" category; For lap-joint flanges, stub ends to be reported under "Fittings" category, while corresponding loose flanges are listed under "Flanges" category;
b) ASME B1.1 UNC Bolt size wise Piping Hardware (viz. machine bolts, stud bolts and nuts only); it shall also include coated bolts, if any.
c) Piping Size (inch NPS) wise Piping Gaskets (segregating Metallic and Non-Metallic types);
d) Piping Size (inch NPS) wise Piping SP Items;
e) Piping Size (inch NPS) wise Piping Valves' MTO of all types of piping valves, for which purchase specifications are issued by Mechanical discipline; Solenoid valves and valve actuators to be by C&I discipline;
f) Piping Size (inch NPS) wise overall piping tonnage, comprising pipes, fittings and flanges (either including or excluding valves); Separate valve tonnage is sometimes useful to forecast valve costs in advance, multiplying with a factor;
g) Overall Pipe Supports Tonnage [viz. Sample Thumb Rule Check: 7.5 to 10 percent of overall piping tonnage or 60% figure of overall Piping Inch-Dia. (unit: Metric Ton), whichever is less];
h) With available Pipe Supports Standard, Pipe Support Tag wise Pipe Supports Tonnage has nowadays become popular; Structural Steel BOQ can be derived from Pipe Support Tag wise Quantification;
i) Piping Size (inch NPS) wise Piping Insulation MTO, with types and thickness of insulation indicated;
j) Piping Size (inch NPS) wise Piping Painting MTO with types of coating and DFT specified;
k) Piping Size (inch NPS) wise Piping Wrapping & Coating MTO with types of wrapping and coating specified;
l) Piping NDT Quantification (Quantification of Pipe Class wise Welding Joints with Piping Size (inch NPS) and %NDT; Reference of XXX NDE specification is useful.);
m) Piping Material (viz. CI, CS, AS, SS, Duplex SS, and Titanium etc.) Category wise Piping Inch-Dia. Summary; Piping Inch Dia. Summary shall include separate columns indicating "Piping Size (inch NPS)" and "Number of Welding Joints" for each "Material Category". This information is useful, for quick reconciliation and MTO data analysis to ascertain cost of fabrication / welding, cost of NDT etc. Sample Inch-Dia. summary sheet is attached herein.
n) Piping Material (viz. CI, CS, AS, SS, Duplex SS, and Titanium etc.) Category wise Overall Piping Inch-Meter Summary; Piping Inch Meter Summary shall include separate columns indicating "Piping Size (inch NPS)" and "Pipe Running Length (Meter)" for each "Material Category". This information is useful, for quick reconciliation and MTO data analysis to ascertain cost of piping erection, labor cost of insulation and painting. Sample Inch-Meter summary sheet is attached herein.
o) Quantification of Utility Hose Stations (SWAN);
p) Additional categorization in terms of "Small Bore" and "Large Bore" Piping MTO are also prevalent. "Small Bore" implies sizes up to and including NPS 2", while "Large Bore" implies sizes above NPS 2". Piping MTO with such categorization ceases to capture realistic feel of quantification and is generally used for planning and not for estimation. Such categorization has found usefulness to gauge and fix priorities, in a schedule driven material delivery scenario.
q) Back end Line-wise Piping MTO to be prepared and maintained with following divisions, assigning appropriate codes for unit / train, system / service fluid, pipe class / piping material specification, schedule / thickness, joining type (viz. socket weld, butt weld, threaded, flanged etc.). Such segregation is useful to ascertain the split of materials and quantities, for quick reconciliation. Such

break down also helps to impart increased confidence level, while re-validating material requirements for different project. It is also considered to be useful database for any kind of electronic reconciliation check, maneuvering and manipulation.

r) For Piping Tie-ins, maintaining a standalone Piping MTO Summary has gained importance to align with the priority of standalone procurement and construction schedule.
s) Hidden requirements of break-up flanges for equipment and at various strategic locations are nowadays separately studied and quantified for the purpose of raising change order, if any.
t) Hidden requirements of Full Coupling, Unions, Plugs and Blind Flanges are also separately studied, quantified and ascertained to gauge effect of threaded, galvanized pipe class and Piping & Instruments Hook-Ups and Interface.
u) Hidden requirements of stem extension for Pit Valves are often studied and quantified.
v) Hidden requirements of fabrication wastage for pipes / plates and welding qualification test pieces for pipes / plates are to quantified, based on historical data.
w) Hidden requirements of pipe quantities used for pipe supports trunnions / stanchions and for circular structural members are to be quantified, based on historical data.

It is worth mentioning that with the evolution of rule-based material libraries, being used internationally, material database are nowadays developed, maintained and controlled in a structured manner, introducing primary key and secondary database keys like, material group, component group, commodity codes, part numbers etc.

It is believed that above points can be appended further or can be made comprehensive with feedback from process owner / activity doers. Please feel free to send your feedback / comment, through e-mail, for further process improvement / thought process.

Legend / Acronym:
BOQ = Bill of Quantities;
MTO = Material Take-Off;
NPS = Nominal Pipe Size (inch NPS or mm NB);
NB = Nominal Bore (inch NPS or mm NB);
ASME = American Society of Mechanical Engineers;
EIL = Engineers India Limited;
UNC = Unified Thread Coarse;
C&I = Control & Instrumentation;
Piping SP = Piping Special Items viz. Hoses, Couplers, Adaptors, Injection Quills, Steam Traps, Sample Coolers, Steam Distribution Manifolds (SDMs), Condensate Collection Manifolds (CCMs), Stem Extensions for Valves, Chain Operation Sprocket Wheels for Valves etc.;
NDT = Non-Destructive Testing;
NDE = Non-Destructive Examination;
SWAN = Steam, Water, Air and Nitrogen;
DFT = Dry Film Thickness;
CI = Cast Iron;
CS = Carbon Steel;
AS = Alloy Steel;
SS = Stainless Steel;

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Material Specification Category	Schedule / Wall Thk.	Nominal Pipe Size [Inch NPS]	Pipe Length [m]	Inch-Meter	Elbows & alike Qty.	Flanges & alike Qty.	Tees & alike Qty.	Reducers & alike Qty.	Inch-Dia	Remarks
Carbon Steel	Sch.80	0.50	574	574	305	313	78	86	1425	BWE
Carbon Steel	Sch.80	0.75	393	393	155	88	38	98	774	BWE
Carbon Steel	Sch.80	1.00	595	595	173	149	30	31	747	BWE
Carbon Steel	Sch.80	1.50	170	255	24	18	2	3	161	BWE
Carbon Steel	Sch.80	2.00	1043	2086	353	233	93	60	3024	BWE & BWE
Carbon Steel	Sch.STD	2.50	6	15	0	3	0	0	13	BWE
Carbon Steel	Sch.STD	3.00	770	2310	262	164	47	34	3078	BWE
Carbon Steel	Sch.STD	4.00	514	2056	241	167	184	20	5308	BWE
Carbon Steel	Sch.STD	5.00	21	105	10	0	3	0	165	BWE
Carbon Steel	Sch.STD	6.00	748	4488	280	155	[illegible]	27	6906	BWE
Carbon Steel	Sch.STD	8.00	384	3072	55	31	21	2	2184	BWE
Carbon Steel	Sch.STD	10.00	430	4300	57	36	[illegible]	0	3270	BWE
Carbon Steel	Sch.STD	12.00	6	72	2	11	2	0	276	BWE
Carbon Steel	Sch.STD	16.00	2	32	0	4	0	0	80	BWE
Total			**5656**	**20353**	**1897**	[illegible]	**632**	**361**	**27410**	
SS 304	Sch.40S	0.50	490	490	250	[illegible]	48	95	1089	SWE & BWE
SS 304	Sch.40S	0.75	184	184	59	[illegible]	9	34	303	SWE & BWE
SS 304	Sch.40S	1.00	1230	1230	397	[illegible]	68	87	1764	SWE & BWE
SS 304	Sch.40S	1.50	1245	1868	345	371	77	5	2265	SWE & BWE
SS 304	Sch.40S	2.00	2290	4580	[illegible]	685	178	18	5970	SWE & BWE
SS 304	Sch.10S	3.00	1012	3036	368	406	74	11	4665	BWE
SS 304	Sch.10S	4.00	740	2960	[illegible]	264	53	11	4172	BWE
SS 304	Sch.10S	6.00	15	90	9	12	0	0	198	BWE
SS 304	Sch.10S	8.00	73	584	[illegible]	46	3	4	1216	BWE
Total			**7279**	**15022**	**[illegible]077**	**2402**	**510**	**265**	**21642**	
SS 316L	Sch.40S	0.50	6	6	0	8	3	4	27	SWE
SS 316L	Sch.40S	0.75	6	[illegible]	0	15	2	5	33	SWE
SS 316L	Sch.40S	1.00	13	[illegible]	12	19	7	10	87	SWE
SS 316L	Sch.40S	1.50	6	[illegible]	0	5	0	2	17	SWE
SS 316L	Sch.40S	2.00	220	440	72	57	6	2	520	SWE & BWE
SS 316L	Sch.10S	3.00	10	30	4	8	0	2	66	BWE
SS 316L	Sch.10S	4.00	[illegible]	268	23	28	5	2	420	BWE
SS 316L	Sch.10S	6.00	[illegible]	36	3	3	0	0	66	BWE
SS 316L	Sch.10S	8.00	[illegible]	136	12	17	2	2	432	BWE
Total			**[illegible]51**	**944**	**126**	**160**	**25**	**29**	**1688**	
Hastelloy C-276	Sch.80	0.50	4	4	0	8	0	4	17	BWE
Hastelloy C-276	Sch.80	0.[illegible]	3	3	0	3	0	0	4	BWE
Hastelloy C-276	Sch.80	1.0[illegible]	3	3	6	9	0	4	30	BWE
Hastelloy C-276	Sch.80	[illegible]	4	6	0	2	2	0	14	BWE
Hastelloy C-276	Sch.80	2.0[illegible]	4	8	6	16	0	2	66	BWE
Hastelloy C-276	1/4" Thk.	3.00	20	60	10	11	2	2	135	BWE
Hastelloy C-276	1/4" Thk.	4.00	6	24	3	9	3	0	104	BWE
Hastelloy C-276	5/16" Thk.	8.00	18	144	9	15	2	0	344	BWE
Total			**62**	**252**	**34**	**73**	**9**	**12**	**714**	
	Sch./Thk.	NPS	Meter	Inch-Meter	Nos.	Nos.	Nos.	Nos.	Inch-Dia	Remarks

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